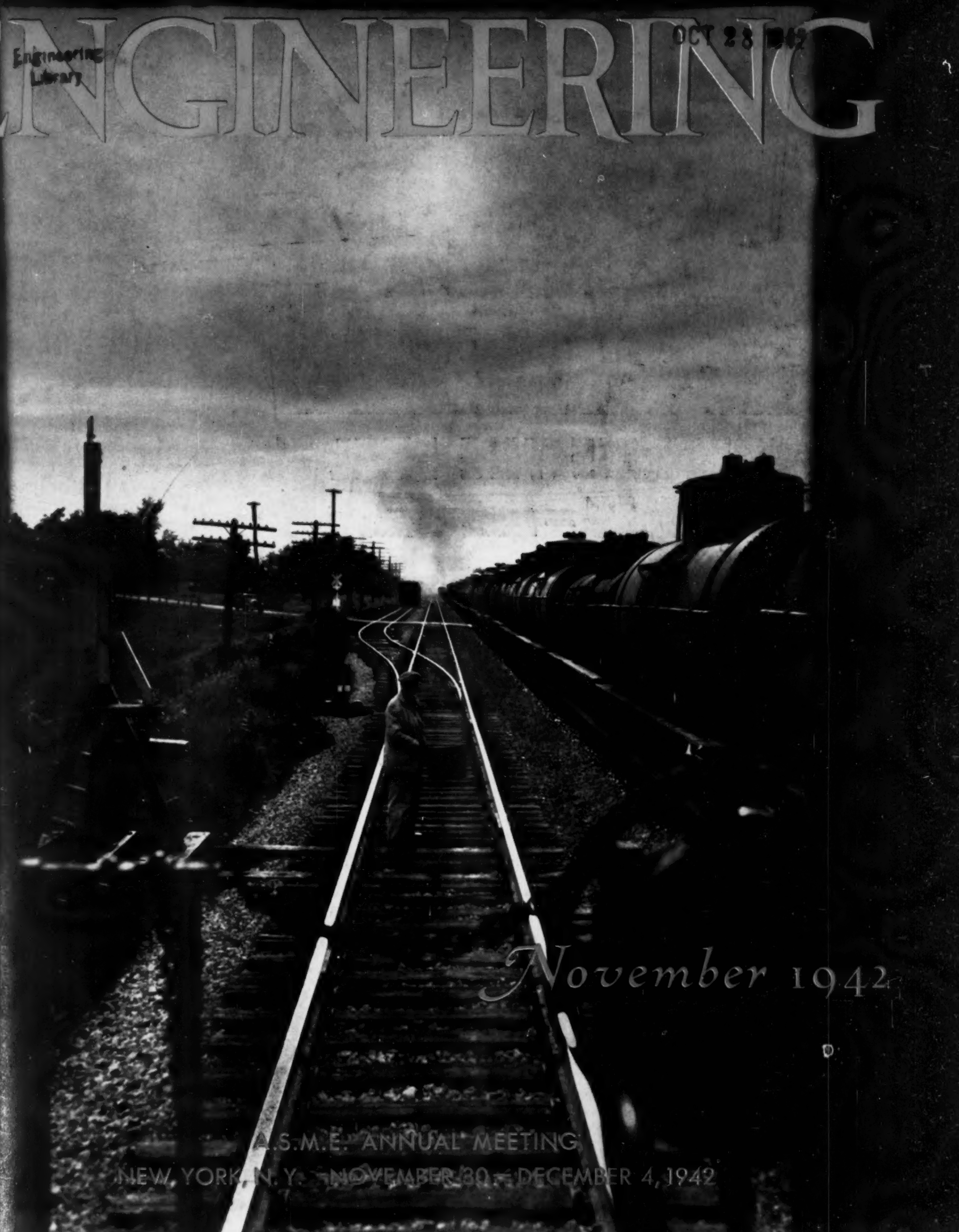
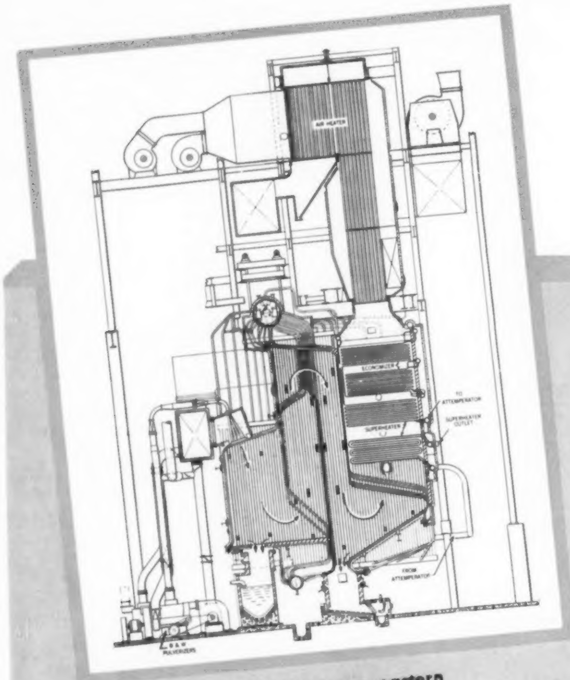
MECHANICAL ENGINEERING

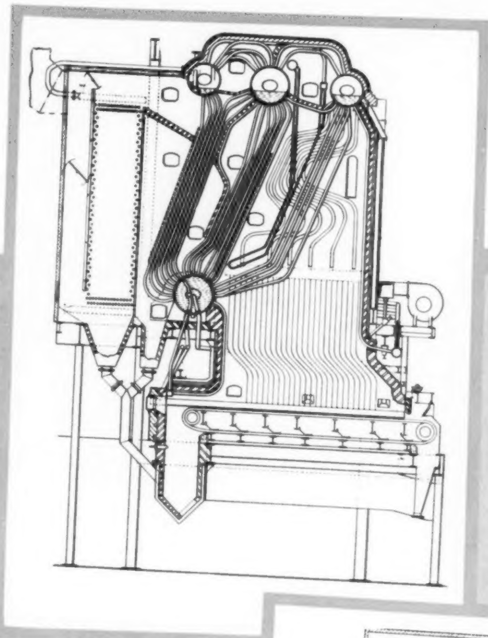


November 1942

A.S.M.E. ANNUAL MEETING
NEW YORK, N.Y. NOVEMBER 30 – DECEMBER 4, 1942

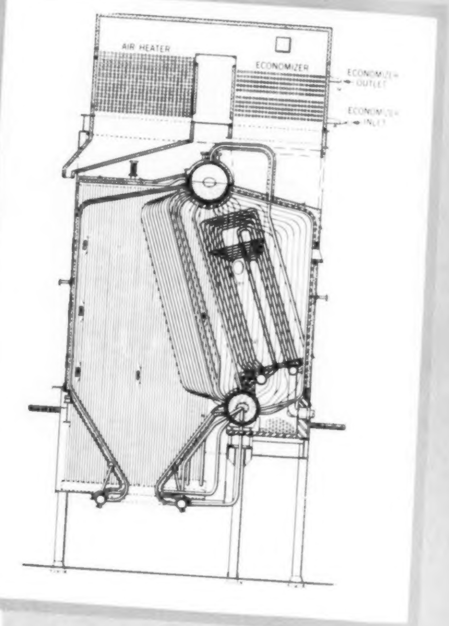


B&W Open-Pass Boiler in an eastern central station — Capacity 350,000 lb. steam per hr. — Direct fired with high-volatile eastern bituminous coal.



Stirling Boiler in a mid-western municipal electric light plant — Capacity 125,000 lb. steam per hr. — Fired with high-volatile Indiana bituminous coal on a B&W Chain-Grate Stoker.

B&W Integral-Furnace Boiler for an eastern central station — Capacity 150,000 lb. steam per hr.—Direct fired with high-volatile Kentucky bituminous coal.



COAL MEETS THE FUEL EMERGENCY — *Pulverized and Stoker Firing . . . . .*

Steam plants today must be operated in the interest of the war effort, releasing from use the fuels needed by combat units. This has placed on coal the burden of carrying today's production load. With coal, as with other fuels, it is vital that it be burned economically and with minimum interruption to service. In the field of coal burning, B&W can be of great service to coal users, because of its invaluable knowledge and experience in the combustion of this and other fuels and through the coal-burning equipment it has made available.

The B&W Direct-Firing System is the result of the Company's lengthy experience with pulverized-coal firing, an experience that dates back to the earliest applications to power boilers. This system is fully coordinated, from bin to burners; the ball-bearing type pulverizer and rotating-table feeder being especially applicable to direct firing and to complete automatic control.

B&W Chain-Grate Stokers are widely used where economic considerations, size of boiler, and character of coal available make stoker firing advisable. These stokers burn a wide range of coals efficiently, are self-cleaning and low in maintenance.

B&W Water-Cooled Furnace Constructions have the diversity necessary for satisfying all the requirements of any method of firing, from supplying structural shape and strength, to promoting combustion and ash elimination in individual furnaces.

Complete B&W Boiler Units, such as those shown on these pages incorporating either method of firing and typical B&W Furnace Constructions, provide the means of meeting present-day fuel problems.

The Babcock & Wilcox Co. · 85 Liberty St. · New York, N. Y.

BABCOCK & WILCOX

The Maritime Victory flag and "M" burgee now float proudly alongside the Navy "E" at the Barberton Works. Each is an award for "outstanding achievement" and is "an honor not lightly bestowed".

Enough man-days were lost through accidents last year to have produced 300,000 light tanks. To help minimize such losses, this Company has subscribed to the National Safety Council's War Production Fund to Conserve Man Power.

G-235

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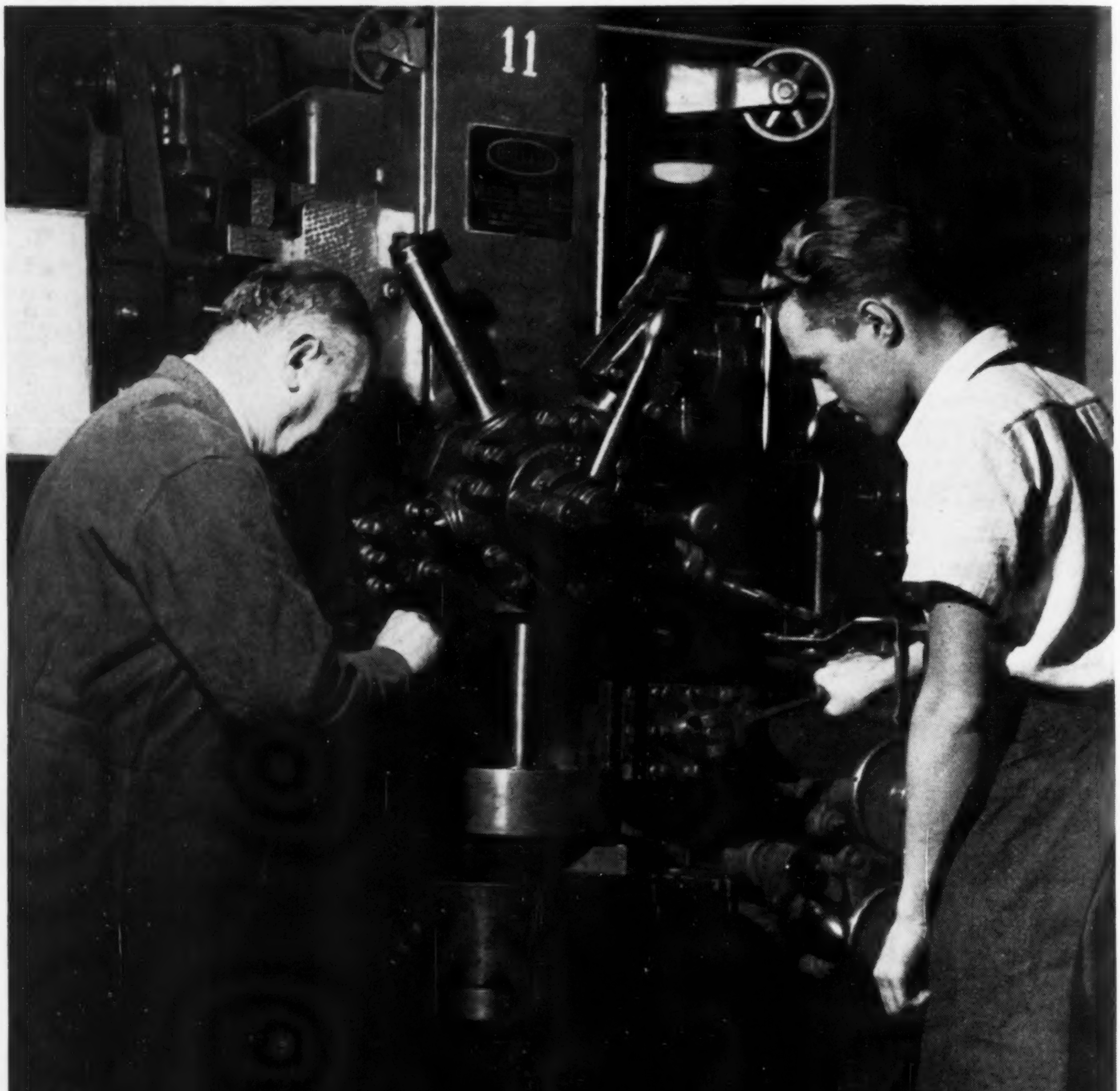

Cushing, N. Y.

Training for the Production Front

(*Apprentice Student and Instructor at the Polytechnic Institute of Brooklyn*)

Volume 64
No. 11

MECHANICAL ENGINEERING

November
1942

GEORGE A. STETSON, *Editor*

Face Lifting

MEMBERS of The American Society of Mechanical Engineers who will attend the 1942 Annual Meeting of the Society, to be held at the Hotel Astor, New York, N. Y., November 30–December 4, will have an opportunity to inspect and admire the redecorated A.S.M.E. headquarters in the Engineering Societies Building.

For the first time in many years a thorough job of redecoration has been attempted in the public rooms of the Society, which include the lobby and its alcove, the Council room, and the members' room. A new floor, of richly colored and highly polished walnut, has been laid. Walls and woodwork have been repainted to bring warmth and light, as well as color, into the background. New lighting effects have been adopted, the Society's oil paintings have been cleaned and repaired and rehung, and the furniture has been recovered or refinished and a few new pieces have been added. For the first time a prominent place, with good lighting, has been found for the unique self-portrait of Robert Fulton, one of the Society's cherished possessions.

The scheme of decoration chosen is distinctive for each of the three major rooms but harmony has been achieved. The lobby presents a dignified but homelike appearance, the concealed lighting making up for lack of exterior windows. The rich simplicity of the members' room, with its inviting furniture and restful decoration, has the atmosphere of a club lounge. The Council room, in addition to its improved appearance, has been made more useful for meeting purposes by the rebuilding of the Council table so that it can serve large and small groups.

It is hoped that, although technical sessions and committee meetings must be held at the Hotel Astor to afford sufficient meeting capacity, members will make it a point to visit their headquarters sometime during their stay in New York and inspect the redecorated rooms. They will be proud of their Society's home and even more willing than in the past to make it their headquarters whenever business brings them to New York.

10-Day Launch

THE launch on September 23 of a 10,500-ton Liberty ship 10 days after its keel was laid, 87 per cent complete, with boilers installed and steam up, is one of those wartime records that makes headlines.

It detracts nothing from the significance and importance of this record to recall that the method of construction at the Oregon yard is an adaptation of the assembly-line methods made famous by the automobile industry and adopted by every other industry engaged in mass production. In the case of the ship, large sections are assembled "off stage" and are brought to the ways to be joined together for the final assembly of the complete structure. To achieve such a record the preliminary steps of fabrication of the subassemblies must be carefully scheduled and co-ordinated. Welding and other techniques are unquestionable aids to speed of construction, but perhaps the greatest achievement lies in the field of management. Good cooks have had their measure of praise, but the unsung heroes of a good meal are the housewives and maîtres d'hôtel who make it possible for the food to appear at the proper time and in proper condition without confusion or delay. In construction and manufacturing this co-ordination through proper scheduling and production control is the function of engineers.

Because engineers have been so successful in the smooth efficient management of industrial enterprise where volume, speed, and low cost of production are attained by skillful planning and co-ordination, they have basis for the hope that the principles involved can be applied to the national economy, given the proper political and social environment in which to work. The present war is developing an unusual number of men with these skills. If our leaders are wise they will turn to engineers for the operation of large segments of postwar economy and will leaven their own methods in planning with those so successfully employed by engineers in industrial enterprises.

Don't Waste It

TODAY'S newspapers and magazines are alive with the urge to "get in the scrap" for the successful prosecution of the war. Readers of MECHANICAL ENGINEERING will recall that attention was directed to the urgency of conservation, substitution, and salvage at the 1941 Annual Meeting of The American Society of Mechanical Engineers, when a well-attended clinic was held, and by many papers on the subject that were published during the early and late spring. That the timing of these efforts to arouse interest in salvage and waste antedated the national campaign by several months is testimony to the alertness of the programs of the Society.

Engineers recognize the value of salvage at all times. It is always part of their job. Their interest goes beyond the saving of materials alone to the saving of energy and time. In fact, that much abused word "efficiency" is the

engineer's criterion of praiseworthy accomplishment. The engineer prides himself on utilizing to the fullest extent the last heat unit, the stray lumen, the quickly passing minute of time, as well as manual labor, physical health, eyesight, and nervous energy of workers. He has been defined as the man who can do with one dollar what any person can do with two. Waste is anathema to him at all times.

However natural it is for the engineer to think in terms of efficiency, he is constantly amazed at the possibilities that present themselves once the need becomes insistent. The Westinghouse Company recently announced how astonished were its engineers whose duty it was to concern themselves with salvage techniques to find scrap materials even they had overlooked. Outside the field of materials opportunities for saving waste are cropping up every day to astonish all of us. The du Pont Company recently showed a few accident-prevention engineers and editors what can be done by intelligent color combination in the painting of shop walls, ceilings, floors, and machinery. Present-day conditions may make it impossible to reconstruct a lighting system to increase production and decrease industrial accidents. In connection with engineers of the Philadelphia Electric Company, the du Pont engineers have been studying the problem of better lighting by proper painting. Increases in illumination efficiency of astounding proportions have been reported in cases where carefully chosen paints have permitted the efficient reflection of light from surfaces that formerly absorbed a large percentage of light rays and by contrasting color schemes that aid the workman to see more clearly the work he is engaged upon and the accident-provoking parts of the machine he is tending. Here again the engineer is in the front of the public procession of progress in salvage.

In saving that precious possession, time, all of us can improve our habits. Here again this magazine has directed attention to the seriousness of irretrievable losses. A statement of the A.S.M.E. National Defense Committee, now known as the A.S.M.E. War Production Committee, published many months ago, dramatized the seriousness of wastage of time by saying that "Congress cannot appropriate one second of time," and time is essential in the war effort. When the demand on man power grows to the point of utilizing the entire population, as is rapidly becoming the case, the better utilization of time alone must make up for deficiencies. We started late, we delayed our full effort, and we still face the possibility of a defeat that better utilization of time can prevent. Here everyone can help, just as he can in cleaning his shop, his attic, and his back yard of idle scrap.

It remained for a student engineer at the General Electric Company, in an assignment given him in a course in expression, to call attention to some of the simple ways in which time can be saved. What this young man had to say to his fellow engineers is printed on page 806 of this issue. All of us can take it to heart. More than this, every one of us can cut out the brief article and put it in a prominent place in his house or near his place of work to remind us constantly that we must not waste our own time or steal from another what can never be returned.

Selection and Guidance

AT THE Annual Meeting of the Engineers' Council for Professional Development, held in New York on October 18, Dean R. L. Sackett, for the Committee on Selection and Guidance, presented a report covering ten years of this committee's activities. It detracts little from the credit due the other members of this committee to recognize the leadership of Dean Sackett in the ten years of pioneering undertaken by the committee.

It is an obvious truism that the quality of the engineering profession is improved by the intelligent selection and guidance of the young men who elect to enter it. Native talent and early awakened interest in engineering as a career will always provide a source of recruits to the engineering profession. The accidents of opportunity will force men into engineering pursuits even when they have not planned as youths to undertake them. Although this haphazard method has developed engineers in the past and will continue to do so in the future, it is obviously wasteful of man power and causes many misfits, disappointments, and, possibly, frustrated careers.

Dean Sackett and his committee have tackled the problem in an intelligent and scientific manner. They have studied the possibilities that lie in tests of young men to determine in advance of entry into engineering colleges the aptitudes for engineering careers of high-school students, and they have tested the validity of the tests themselves. Moreover, the guidance that leads to intelligent selection has a twofold quality. It not only affords the means of weeding out young men who are probably unfitted to become engineers but it also provides an opportunity for others who have the talent and temperament to consider engineering as a career and inform themselves concerning it in cases where no personal predisposition or influence from parents, teachers, or friends has existed. Certainly the young men themselves, and the profession of engineering, are the gainers when wise selection and guidance procedures are put into practice.

Much is said and written about the role of the engineer in modern society and in the growing influence of engineers and their methods of work in the reconstruction of a postwar society. Numbers are important and will become of even greater importance, but quality means more to the world than numbers. The present world war demonstrates how false leadership can warp the minds of youth and divert the constructive forces of science and engineering to destructive ends. It may be too much to hope that engineers of the future will be wise enough in leadership and in their selection of leaders and social philosophies to deny use of their talents for the destruction of civilization. Much will depend on the quality of men who enter the engineering profession and on the educational experiences they undergo in preparing for their careers. The work which Dean Sackett's committee has launched, supplemented by the improvement of educational and professional standards on which other E.C.P.D. Committees are engaged, will be powerful forces in providing men of the quality needed to advance, rather than destroy, our civilization.

COAL FOLLOWS THROUGH

By E. G. BAILEY

VICE-PRESIDENT, THE BABCOCK & WILCOX COMPANY, NEW YORK, N. Y.

PLANTS which normally burn coal are now able to obtain a substantial increase over their normal supply for their greater power needs and also additional tonnage for extra storage against the uncertainties of the future. Many plants previously burning oil or gas have already been converted to coal and those which must or should change to coal will undoubtedly be able to obtain ample tonnage of coal of standard quality at reasonable prices.

What a contrast this is to the conditions of 25 years ago, when the shortage of coal and transportation led to prices of $5 to $6 per ton at the mines, and degradation of quality, until the already overburdened railroads were called upon to haul 100,000 tons per day of extra ash alone. This was the result of a runaway market and the loading of gob, slate, and subquality coal, amounting to an estimated increase in ash of 5 per cent of the total tonnage hauled. The problem of getting increased steam output from inferior coal caused unbelievable reductions in the then low normal boiler efficiency and untold labor in firing the hand- and stoker-fed furnaces of that day.

In comparison with the last war, our proportionate increase in production of war equipment is undoubtedly greater as of today. Coal has already been called upon to replace other fuels that were not then a factor. A wider range of coal is more readily usable in the average plant at a very much higher normal efficiency. The quality of coal now being shipped is very much better and should remain so. The railroads are doing a wonderful job in hauling the extra coal tonnage for current use and storage; they are also doing a herculean task in shipping oil and gasoline over unusual routes.

We should not be too quick and loud in singing our own praises, because the worst is yet to come. We have done only what is expected of us and perhaps not all of that. We face many problems which lie in borderline cases of proved experience and knowledge. Many uses of coal, that are still in the realm of the unknown, may have to be undertaken as practical experiments.

The British thought they were getting along satisfactorily with their coal problem in the early days of the war, but this coming winter is now recognized as a severe test. Their first step is to check the efficiency of all power plants, with a view to favoring the more efficient ones in case rationing of coal becomes necessary.

COAL STORAGE

Coal is the outstanding raw material of which there has been plenty, and which users are urged to hoard.

Storage piles are larger and more numerous than ever before. The Bureau of Mines and many technical publications have made wide distribution of instructions and helpful guides on methods for storage to prevent spontaneous combustion. Unfortunately, not everyone who should have profited by such advice has done so, and some storage piles are already hot and many more are likely to catch on fire.

With so much available knowledge on the causes and prevention of spontaneous combustion, it amounts to criminal negligence to allow a fire to occur in coal storage.

Data and statistics should be collected from this year's experiences and made available through publication of more detailed instructions and precautions for storage during the next summer season, since coal stored from now on is not likely to heat unless left through next summer.

COAL FOR STEAM BOILERS

Plants already burning coal are not likely to experience additional problems, other than those which may accompany higher rates of output or changes in source of coal supply.

There is, however, the large problem of conversion from oil to coal, and this may be divided into two parts:

1 Those where provision for both oil and coal was originally made in buying boiler and furnace equipment.

2 Those where provision for oil alone was made.

In the first group are many where equipment for both oil and coal was purchased and has already operated with both fuels. For them, the changing of fuel is no problem at all. Others in the first group that have not yet burned coal, but have the equipment, now have the problem of buying coal instead of oil and perhaps of working out some problems of coal supply and burner and operating conditions.

In the second group are those who must convert to coal the oil-burning plants which were installed without any provision for burning coal. They are faced with many problems, the first of which is to decide between stokers and pulverized coal. This is usually settled in the smaller boiler units by putting in stokers and in the larger ones by installing pulverized-coal equipment.

In either case, it may be impossible to obtain the same steam output from coal as from oil, due to ash and perhaps slag. More steam capacity by installing new boilers is out of the question right now because of the shortage of critical materials.

With recent additional knowledge regarding coal ash and its slagging characteristics, increased capacity may be obtained at some sacrifice in efficiency by running with excess air higher than normal, at least up to the capacity of the fans and draft equipment available or obtainable.

Another way in which the capacity may be increased and clinker trouble avoided is to cool certain portions of the furnace, where troublesome slag would form, by introducing flue gases from the boiler outlet. Such a system of recirculating flue gases for reducing furnace temperature was first used some forty-odd years ago by Eldred and others for softening the flame in burning lime with coal. It is now used in many processes in the petroleum-cracking industry and will play an important part in superheaters for the synthetic-rubber program, where steam is to be heated to 1400 F. It is more efficient and usually more economical than is the cooling of a furnace by excess air.

A remedy has always been sought for troublesome clinkers in fuel beds, when high combustion rates are required. Water-cooled grates, air-cooled refractory walls, and various other means have accomplished some good, but usually less than desired. Doctoring coal by adding inert materials, which dilute or modify the clinker to a less objectionable state, is being used with some success. Some "treatment" in which small quanti-

Presented at a Joint Meeting of the Fuels Division of The American Society of Mechanical Engineers, and the Coal Division of the American Institute of Mining and Metallurgical Engineers, St. Louis, Mo., Sept. 30–Oct. 1, 1942.

ties of so-called catalysts are added have brought forth many debates. There may be a still better way by carrying finely pulverized material of high fusing nonfluxing qualities into the fuel bed with the air for combustion, following the principle of putting flour on the pie board to keep the dough from sticking. Conclusive research work on all of these suggestions should have been done during the depression, ready for effective use or discard without question in times such as these.

COAL FOR METALLURGICAL USE

A very considerable quantity of oil is used in the eastern coal-market area by metallurgical and ceramic furnaces of a large variety of sizes and purposes, which are often more difficult to convert to coal than are steam boilers.

The convenience of piping oil around to many small burners and the freedom from ash and slag make strong arguments for retaining oil.

In many such furnaces, ash is objectionable but not prohibitive. Those requiring temperatures below 2000 F may use almost any coal without any slag trouble if burned with an oxidizing flame. Temperatures up to 2500 or 2600 F may be attained by selecting coals having ash of very high fusing temperature.

Furnaces requiring 4000 lb of coal per hour or more and equipped with few large burners may best be supplied with individual direct-fired pulverizers. When many furnaces are grouped, or a large furnace requires many small burners, it is probably best to install a direct-fired circulating system. This is a modernization of one of the earliest pulverized-coal systems where coal was continuously circulated with air in a pipe circuit and could be drawn off to individual burners at many places along the circuit. This is now done with a pulverizer in the circuit automatically replenishing the air-and-coal mixture to maintain a constant density. It does away with the troublesome and expensive bin system and is all constructed with explosion-proof piping, pulverizer, blower, and dust-tight shutoff valves. It is as safe and as convenient as a gas-supply system. The off-setting features are the cost of the raw-coal-handling system to the pulverizer, the extra cost of the pulverizer, and the possible problem of ash in the furnace.

Several circulating pulverized-coal bin systems have been operating for more than twenty years. Later installations have been direct-fired, but recently some direct-fired pulverized circulating systems have given excellent results, and more installations are being made. It is not likely that pulverized-coal systems of the bin-and-feeder type will be installed, except as extensions of present equipment. It is not practicable to transport pulverized coal in bulk nor to burn it in house-heating furnaces.

CONVERSION COSTS

The cost of conversion from oil to coal and the attainment of equal results are receiving the best efforts of engineers and equipment manufacturers. Raw-coal storage and conveying equipment is necessarily dependent upon individual conditions, but it is likely to be greater than the cost of all other equipment combined.

Estimates of complete conversion cost have seldom exceeded $1.50 per bbl of present actual oil burned per year. Larger units or more favorable conditions may cost about one half this amount. United States Government agencies have been quoted as insisting on conversions which do not exceed $2 per bbl per year.

At present prices, there is a very large return on the conversion investment for fuel plus operating costs in some instances, some exceeding 75 per cent, while in others, the fuel costs themselves are about on a par.

COLLOIDAL FUEL

During and following the first World War, colloidal fuel, a mixture of approximately 50 per cent oil and 50 per cent pulverized coal, was experimented with extensively, but no commercial installations continued in use.

Renewed efforts to burn colloidal fuel have been attempted during the past few years in Great Britain and in this country. The urge has heretofore come from the coal interests, to obtain half a loaf rather than none. Now the table is turned to the point where the oil interests may be interested in keeping within their control the supply of fuel to certain users, even though the fuel is half oil and half coal.

There is little doubt that conversion from oil should be made to all coal, wherever possible, as the most effective means of conserving oil. Usually, the over-all costs are less, but there may be some conditions where colloidal fuel is the correct answer. Its application in such instances should be made with effective use of the best engineering talent available.

RAILROAD AND BUNKERING FUELS

It has long been recognized that the locomotive with its limitations of space and weight has not kept pace in thermal efficiency with stationary and marine power plants. The railroads deserve great credit for reducing fuel consumption per ton-mile through persistent effort in design and operation within their restricted opportunities. The great majority of eastern roads have fortunately stayed with coal as their basic fuel.

Very little coal is burned in ocean-going ships of American register. The boilers of the Navy are designed for and can function only with oil fuel. The merchant ships are designed for oil, and any steps to convert present ships or design new ones for coal is not considered to be in the best interest of our national defense, for many obvious reasons. Practically all shipping on the Great Lakes and rivers should burn coal. Stokers are mostly used in these services.

DOMESTIC FUEL

Oil for house heating has been the outstanding innovation of the past decade. The consumption of all heating oil has increased about 300 per cent in ten years and now stands at 30 per cent of all fuel-oil consumption. It shows the greatest increase of any market for petroleum production and it may result in the biggest headache for a large percentage of our population in the eastern states.

What is the answer? Convert to coal? Yes, but that is easier said than done. There is no good and complete answer to this situation right now with October frost and winds at hand. Many may have to shiver through this winter, but it is time to start planning for the next.

The coal industry is more at fault in not having made more progress in house heating than in any other field available to it. Not only should it have sponsored the sale of more stokers of known design, but it should have perfected coal-burning equipment for the home that would so far excel any that is now available that the problem of conversion would not exist.

SUGGESTIONS FOR THE FUTURE

It is very easy to recognize mistakes of the past, not only in the fuel situation, but in armament, rubber, and scrap iron. There are, however, different degrees of blindness and gullibility that should be analyzed for guidance of future generations.

The industrial areas in the eastern part of our country have been developed largely because of the abundance of coal and iron. That, for the sake of a little more comfort, a little less work and dirt, so many people transferred their faith from coal to a fuel coming from a source more than 1500 miles distant,

(*Continued on page 786*)

Some Features of the

HARBOR STEAM PLANT

of the Los Angeles Bureau of Power and Light

By WILLIAM C. ROWSE

LOS ANGELES BUREAU OF POWER AND LIGHT

THE Bureau of Power and Light of the Department of Water and Power of the City of Los Angeles, California, is a municipally owned corporation serving electrical energy to all consumers within the city limits except street railways. For brevity, it will hereinafter be referred to as the "Power Bureau."

Many years ago Power Bureau engineers worked out a comprehensive general plan for future generating and distributing facilities to meet the anticipated growth of load on the Power Bureau's system. The broad conception of this general plan contemplates adding central receiving stations in Los Angeles near load centers as increased demand for electrical energy dictates, each central receiving station to be supplied with electrical energy at high voltage from one or more generating sources. The present generating sources are the Los Angeles Aqueduct hydro plants, Boulder Dam, Alameda steam plant, Seal Beach steam plant, and one leased steam unit. These generating sources deliver energy over high-voltage transmission lines to six central receiving stations which, in turn, are connected by a high-voltage transmission line, known as the "belt line," in order to make energy available to any receiving station from any of the generating sources, either during normal operating conditions or in emergencies.

In further accordance with the general plan, the Power Bureau had acquired a site for the Harbor steam plant just north of Los Angeles Harbor Department property and close to the necessary large supply of condenser cooling water. Studies and experiments in connection with the harbor water and the general suitability of the site were carried on over a period of several years under the supervision of Dr. W. F. Durand, consulting engineer. All available records of the U. S. Weather Bureau, the Los Angeles Harbor Department, and the Marine Exchange relating to temperature of harbor water, temperature and humidity of air, and directions and velocities of wind were studied. A meteorological station was set up to obtain with considerable accuracy over a period of one year information regarding evaporation from water surfaces for air temperatures, humidity, and velocities, and directions of wind prevailing at the Harbor for elevations of air temperatures of 0 F, 5 F, and 10 F above the temperature of the water in the harbor. In addition, a model of the harbor was constructed with means for simulating the tides for the purpose of obtaining information on the behavior of harbor currents when pumping water from slip 5 into the west basin.

On the basis of these studies and other considerations Dr. Durand reported: (1) That the temperature of the water is remarkably uniform throughout the year, varying between 50 F and 75 F and averaging 60 F; (2) that the chemical and biological analysis of samples of harbor water taken at weekly intervals over a period of one year show that the harbor water is not unduly corrosive; (3) that the most serious effects to be guarded against are the corrosive effect of free oxygen in the water and the growth of slime, or algae, on the inside surface of the condenser tubes; and (4) that he would have no hesitancy in constructing a steam plant on this site which would have the contemplated ultimate capacity of 300,000 to 350,000 kw, or even more.

GENERAL CHARACTERISTICS

During the latter part of 1939, it became evident that the large, though limited, shop capacity in the United States for building large steam-turbine-generator units and large steam boilers was rapidly being filled up with orders owing to the Navy expansion program and the placing of orders for new equipment by power companies throughout the country in anticipation of increased manufacturing loads. As this condition resulted in delayed deliveries of equipment, it became apparent that the Power Bureau would have to plan three years ahead instead of the customary two years.

After several conferences it was decided that the size of the first steam-turbine-generator unit of the Harbor steam plant

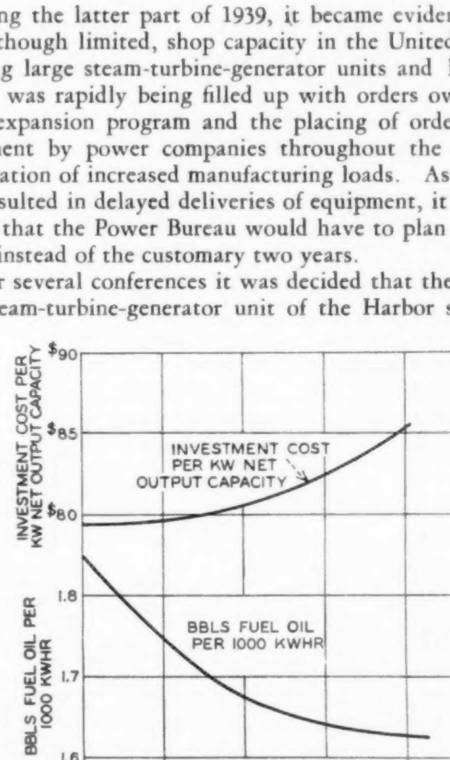

FIG. 1 GRAPHIC ANALYSIS OF STUDY "Y"—EFFECT OF STEAM PRESSURE AND TEMPERATURE

Presented at a joint meeting of the Los Angeles section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the American Institute of Electrical Engineers, Los Angeles, Calif., Jan. 13, 1942.

TABLE 1 SUMMARY OF STUDY "Y." COMPARATIVE ANNUAL COSTS PER KILOWATT OF NET PLANT CAPACITY BASED ON THE ULTIMATE INSTALLATION OF FOUR 75,000 KW, 1800 RPM, SINGLE-CYLINDER TURBINE GENERATOR UNITS

Annual capacity factor, per cent	5	10	20	40	60	80	100
Fuel at $0.90 per bbl	—Dollars per year per kw of net capacity—						
400 psi (gage), 750 F	**7.92**	8.65	10.10	13.00	15.92	18.83	21.73
650 psi (gage), 825 F	**7.92**	**8.60**	**9.97**	12.67	15.41	18.13	20.86
850 psi (gage), 900 F	8.09	8.74	10.05	**12.66**	**15.28**	**17.89**	**20.51**
1250 psi (gage), 900 F	8.31	8.96	10.24	12.81	15.37	17.94	**20.51**
Fuel at $1 per bbl							
400 psi (gage), 750 F	**8.07**	8.88	10.49	13.72	16.96	20.19	23.42
650 psi (gage), 825 F	**8.07**	**8.82**	**10.34**	13.36	16.39	19.41	22.44
850 psi (gage), 900 F	8.23	8.95	10.41	**13.31**	**16.22**	**19.12**	22.03
1250 psi (gage), 900 F	8.45	9.17	10.59	13.45	16.30	19.15	**22.01**
Fuel at $1.10 per bbl							
400 psi (gage), 750 F	**8.22**	9.11	10.88	14.44	18.00	21.57	25.11
650 psi (gage), 825 F	**8.22**	**9.04**	**10.71**	14.05	17.37	20.69	24.02
850 psi (gage), 900 F	8.37	9.17	10.77	**13.96**	**17.16**	**20.35**	23.55
1250 psi (gage), 900 F	8.59	9.38	10.94	14.09	17.23	**20.36**	**23.51**

would be between 60,000 and 75,000 kw and that the plant should have suitable general characteristics for operating in parallel with hydroelectric generating plants, including the ability to operate over a wide range of load factors with reasonably good economy and to pick up full load instantly when floating on the line at a light load. The author was instructed to prepare a comprehensive report covering a range of steam-turbine electric-generating units as to size, speeds, throttle steam pressures and temperatures, and types of units suitable for such general plant characteristics.

ECONOMIC STUDIES

This report, which was completed late in March, 1940, included two economic studies (referred to as study "X" and study "Y") which took into consideration fixed charges on investment, fuel efficiency, cost of fuel, operation and maintenance expense, and power required by the station auxiliaries. All calculations were based on the ultimate capacity of approximately 300,000 kw and on the net sendout from the plant. Special care was taken to make all results truly comparable.

Study "Y" compared the effect of a range of steam pressures and temperatures at the throttle of the same steam-turbine-generator unit. Fig. 1 charts these factors and shows: (1) that while the investment cost advances at an increasingly rapid rate as the steam pressure and temperature are increased, the fuel consumption goes down at a decreasing rate; (2) that the operation and maintenance expense is practically uniform for all pressures; and (3) that the power required by auxiliaries increases with the rise in steam pressure.

In Table 1, which presents the results of economic study "Y," bold-faced numerals indicate the most economical steam conditions over a range of annual capacity factors from 5 to 100 per cent. It is expected that the first unit will operate over a wide range of capacity factors, with an average capacity factor of the order of 40 to 50 per cent during its active life, and it is evident from Table 1 that, from the standpoint of economic cost, nominal steam conditions at the turbine throttle should be 850 psi gage and 900 F.

Study "X," which compared various sizes, speeds, and types of steam-turbine-generator units, indicates that the 65,000-kw, 3600-rpm, tandem compound unit (the largest 3600-rpm unit manufacturers were prepared to build) and the 75,000-kw, 1800-rpm, single-cylinder unit are about equal from the standpoint of economic cost of power. However, the 65,000-kw, 3600-rpm, tandem compound unit has many advantages, particularly for instantaneous pickup of load, since the rapid change of temperature from 700 F at light load to 900 F at full load in three to five minutes will affect only the relatively small high-pressure turbine.

From these and many other considerations, it was decided: (1) That the first unit of the Harbor steam plant would consist of a 65,000-kw, 3600-rpm, tandem compound turbine-generator unit, with nominal steam conditions at the turbine throttle of 850 psi gage and 900 F; (2) that steam should be supplied by a single steam-generating unit, designed to burn oil or natural gas, with a normal continuous operating capacity of 570,000 lb of steam per hour (sufficient for a load of 65,000 kw on the turbine-generator unit) and a two-hour capacity of 675,000 lb of steam per hour (sufficient for a load of 75,000 kw on the turbine-generator unit); (3) and that the design of equipment for the first unit should be based on a maximum load of 75,000 kw for two hours.

QUICK PICKUP OF LOAD

The requirement of quick pickup of load also affected the design of the boiler. When the turbine-generator unit is floating on the line carrying 5000 kw load, the turbine is operat-

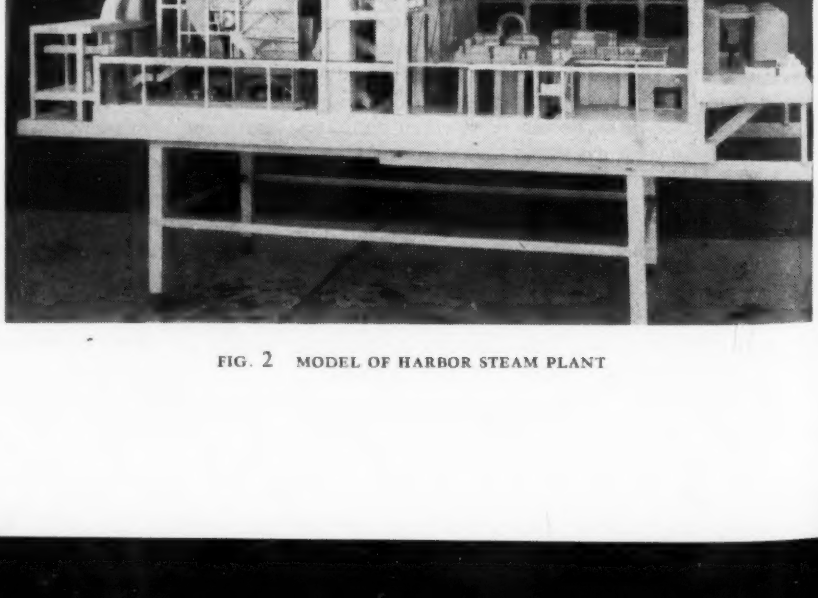

FIG. 2 MODEL OF HARBOR STEAM PLANT

ing on a "blocked" governor and consuming steam at the rate of 60,000 lb per hr, and the furnace is burning fuel oil at the rate of 4320 lb per hr. When the load on the turbine-generator unit is instantly increased to 65,000 kw, the momentary falling off of the speed of the unit trips the blocked governor, the turbine throttle opens to a point determined by a preset load-limiting device, and the rate of steam flow almost instantly increases from 60,000 to 570,000 lb per hr. It will take 20 to 25 sec to increase the firing rate of the fuel-oil burners, and during that period the additional steam required to carry the added load will have to come from the accumulator effect of the heat stored in the hot water in the boiler. The only way to change the heat stored in the hot water into steam is by a drop in the boiler pressure. This pressure drop is limited by the lowest steam pressure at the throttle at which the turbine can carry this load. For this maximum permissible drop in pressure, each pound of water in the boiler will release a given amount of heat in the form of steam. It therefore follows that the higher the pressure and the greater the amount of water in the boiler when the turbine generator is carrying a load of 5000 kw, the greater will be the amount of stored energy available during the 20 to 25-sec period in which the rate of burning fuel must be increased to a rate greater than the 40,000 lb per hr required to produce 570,000 lb of steam per hour and that will not only stop the drop in boiler pressure but in addition will provide the heat necessary to restore, in a few minutes, the normal pressure and temperature.

Therefore, the specifications called for: (1) A boiler to hold the greatest practicable volume of water below the center line of the main steam drum; (2) a constant-pressure regulator on the main steam drum so that steam pressure at the beginning of quick pickup of load will be more than 100 psi higher than if the usual practice were followed of regulating the boiler in order to keep the pressure constant at the superheater outlet; and (3) burners with a capacity of 60,000 lb of fuel oil per hour.

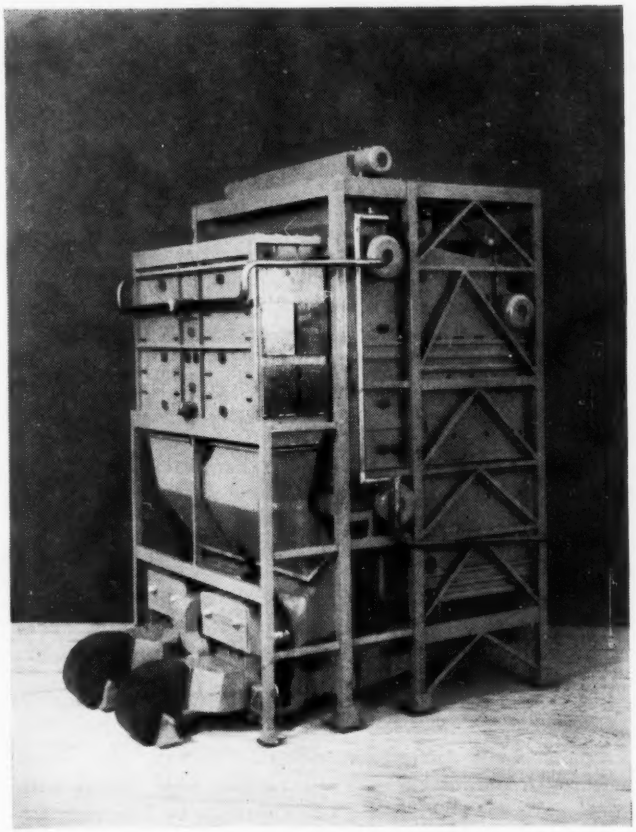

FIG. 4 SCALE MODEL OF STEAM-GENERATING UNIT

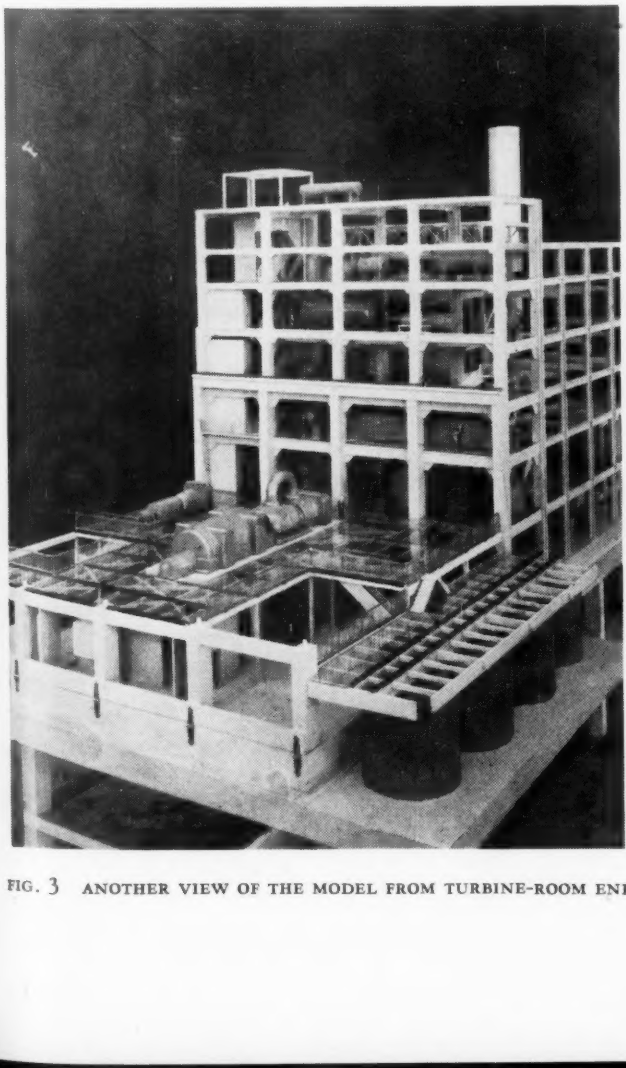

FIG. 3 ANOTHER VIEW OF THE MODEL FROM TURBINE-ROOM END

RELIABILITY OF AUXILIARY DRIVE

A thorough study was made of various methods of assuring reliability of drives for rotating auxiliary equipment in the plant. The possibilities studied included: (1) All steam-turbine drives, which would be uneconomical and present a problem of the disposal of exhaust steam; (2) dual drives, consisting of electric motors for normal operation and steam turbines for emergencies, which would be expensive; (3) a noncondensing, quick-starting house-turbine-generator unit with all auxiliaries motor-driven, which would use enormous quantities of steam just when the total steam capacity was most needed; and (4) a condensing house-turbine-generator unit exhausting into the main steam condenser with all auxiliaries motor-driven. This last method which is the one adopted has many advantages over all the others. In effect it increases the net output capacity of the plant, because the condensing house-turbine-generator unit can carry the station auxiliaries with a reasonable steam consumption and therefore the total output of the main turbine-generator unit can be delivered to the system.

HEAT BALANCE

The first unit of the Harbor steam plant will operate on the straight regenerative steam cycle in which steam will be extracted from four stages of the turbine. The condensate is pumped from the hot well, through the generator hydrogen coolers, the bearing oil coolers, the air jets, and the No. 1 closed feedwater heater in which the water absorbs heat from the steam extracted from the 25th stage of the turbine. From

there the booster pumps force the water through the No. 2 closed heater (where the water absorbs heat from the steam extracted from the 21st stage of the turbine), through the evaporator condenser, into the No. 3 heater. The No. 3 heater is a contact-type deaerating heater in which the feedwater absorbs heat from steam extracted from the 15th stage of the turbine. Attached to the No. 3 heater is a large storage tank containing air-free water, which is pumped by the main boiler feed pumps through the No. 4 closed heater (where the water absorbs heat from steam extracted from the 8th stage of the turbine) into the economizer at a temperature of about 400 F at rated capacity. The extracted steam condenses in the closed heaters and is cascaded to the heater of next lower pressure except in the case of No. 1 heater, where the condensed extracted steam is pumped ahead and added to the condensate. At low loads the condensate passing through the generator hydrogen coolers, the bearing oil coolers, and the air jets is recirculated through the condenser so that at no time does the amount of such cooling water fall below about 180,000 lb per hr. Provision is made for recirculation of water pumped by the boiler feedwater pumps to obtain better regulation at low loads.

The calculated heat consumption of the entire plant, taking into consideration the efficiency of the steam-generating unit and power utilized by station auxiliaries, is about 11,400 Btu per kwhr net station output.

TWIN MAIN STEAM CONDENSER

From economic studies it was decided that the main steam condenser should have 60,000 sq ft of condensing surface with provision for 48,000 gpm of cooling water. Such a condenser would require 10,080 tubes of aluminum-brass, 18 B.W.G., 26 ft long and $^7/_8$ in. outside diameter and would produce an absolute pressure at the turbine exhaust of 1.05 in. Hg at a load of 65,000 kw and of 1.25 in. Hg at a load of 75,000 kw with cooling water at 60 F and tubes 85 per cent clean. This would make it possible to obtain the maximum load of 75,000 kw during the six winter months when the temperature of the cooling water would be 60 F or cooler and when such maximum capacity would be most likely to be needed.

However, difficulties arose in trying to place such a large condenser in the conventional crosswise position directly under the turbine exhaust because of the comparatively small dimensions of the 3600-rpm low-pressure turbine. The only way it could have been done would have been by installing a tall narrow condenser under the turbine. This would have placed the 932,000-lb turbine-generator unit at an unusually high elevation which was undesirable for many reasons, including the difficulty and added expense of designing the foundations to withstand earthquake shocks. After thorough consideration, it was decided to install two half-size condensers longitudinally on each side of the low-pressure turbine foundation with a connecting piece between the turbine exhaust and the two condensers. The advantages of this arrangement are many, including: (1) Low center of gravity of the turbine-generator unit and consequent favorable conditions for foundation design, particularly against earthquake; (2) a low broad foundation to carry both the turbine-generator unit and the condenser, which greatly simplified foundation design; (3) solid bolting of the condenser on its foundations instead of troublesome spring supports, differential expansion being taken care of by rubber-fabric expansion joints between each condenser and the connecting piece; and (4) locating the turbine-room operating floor on the same level with the boiler-room operating floor and only 5 ft above ground level.

USE OF MODEL IN DESIGN

While certain groups of engineers were engaged in solving the many design problems indicated in the preceding paragraphs, another group, known as the Steam Plant Layout Committee, of steam, electrical, and structural engineers, was engaged in making preliminary drawings of various layouts of buildings and structures on the site and of equipment for the building, which necessitated the co-ordination of 150 to 200 preliminary drawings and sketches. All of these possibilities were thoroughly discussed in a series of conferences, and a general layout of the plant was approved. In working out the details a scale model was constructed and kept up to date at intervals as manufacturers' drawings of equipment were approved and as structural, piping, and other details of design were completed. Figs. 2, 3, 4, and 5 show this model and give an idea of the general arrangement of the plant.

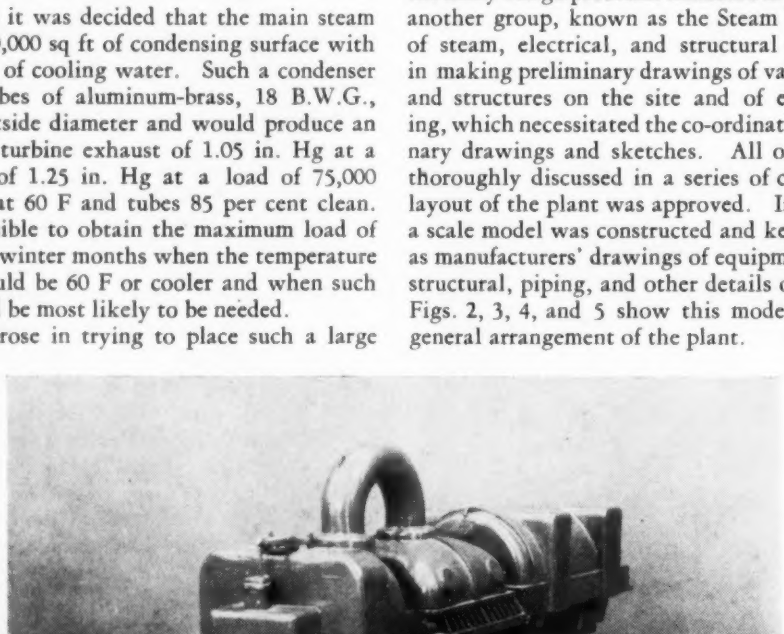

FIG. 5 SCALE MODEL OF STEAM-TURBINE ELECTRIC-GENERATOR UNIT AND TWIN CONDENSERS

HOUDRY PROCESS *for the* *Manufacture of* BUTADIENE

By C. H. THAYER,[1] R. C. LASSIAT,[2] and E. R. LEDERER[3]

THE shortage of natural rubber caused by the war led logically to the application of the Houdry process to the production of butadiene. Houdry's research of catalytic processes since 1923 and experience gained in large-scale cracking and aviation gasoline plants employing his process are fully utilized in the design of Houdry catalytic dehydrogenation plants for producing butadiene.

This article deals with Houdry's two-stage dehydrogenation process for producing 15,000 tons of butadiene per year in each plant. Such a plant is now being built by the Sun Oil Company for the Defense Plant Corporation to supply butadiene to the Rubber Reserve Corporation. This size plant is admirably suited for smaller refineries and for natural-gasoline and recycling plants where a sufficient supply of butane is available. It can be erected also in natural-gas fields where butane is separated from natural gas, while the balance of debutanized gas may be piped away to serve as gas fuel or stored in the ground.

ECONOMY OF MATERIAL

The design of these small butadiene plants permits the use of 60 to 75 per cent of material either existing at such plants or easily available as secondhand equipment. The Sun Oil Company has found sufficient material for the construction of its plant so that of the estimated gross expenditure for this project of $3,254,420 the actual value of the material to be used is $1,720,000; and only $313,686, or 18.2 per cent of this amount is represented by new critical materials requiring priority. The total weight of the material to be used in this project, excluding masonry and lumber, is estimated at 6025 tons, of which 80 per cent, or 4822 tons, consists of existing or secondhand equipment and only 20 per cent of the weight of the total materials entering into the contemplated construction requires priority.

Another advantage of this process and design is that such a plant can be completed and placed in operation within six months after construction has started. After the war, these plants may be converted into units for producing high-octane gasoline and components of aviation gasoline at reasonable cost.

AMPLE SUPPLY OF FEED STOCK

Butane is used as charging stock, although a mixture of butane-butylene can be used and the first stage of the dehydrogenation process eliminated.

Butane, however, is preferred because it is available in large quantities in relatively pure form at refineries, as a by-product of alkylation processes for the manufacture of aviation gasoline, in natural-gasoline and recycle plants. Furthermore, the use of butane does not reduce the raw material needed for the 100-octane aviation-gasoline program as would be the case if butylene is used as feed stock for the production of butadiene.

A careful survey of the potential normal butane production at natural-gasoline plants and refineries in the United States, based on actual 1941 production figures published by the U. S. Bureau of Mines, and published data for the first five months of 1942 permits the following estimate of potential n-butane production for the current and future years up to 1944, inclusive:

From natural gas at gasoline plants	92,000 Bbl per day
From cracking processes at refineries	36,700 Bbl per day
Present in crudes run	50,400 Bbl per day

Normal butane is, therefore, available to the extent of at least 175,000 barrels per day.

Because of the high yield of butadiene obtained from butane in the Houdry process, 44 plants of this type, charging each 677 barrels of butane or a total of about 30,000 barrels daily, can produce 660,000 tons of butadiene annually, sufficient for the final production of 880,000 tons of rubber, or the entire tonnage now proposed by the Government to be produced from petroleum.

By making fullest possible use of existing equipment, an expenditure for new critical material of less than forty million dollars would suffice to build these plants. The first 300,000 tons of annual capacity of butadiene could be in operation within 6 to 7 months and the total required capacity of about 600,000 tons within 9 months after beginning of construction.

DESIGN OF PLANT—PROCESS—YIELD

All Houdry plants are designed to operate on very short on-stream periods. Each on-stream period is followed by a regeneration step, whereby carbon deposited on the catalyst is removed and the catalyst maintained in a very active condition. The useful life of the catalyst is expected to be more than six months. Because of the relatively pure form of the charging stock, the carbon deposit is comparatively small.

High yields obtained in this process reduce the amount of charging stock required and, consequently, also the size of

TABLE 1 OVER-ALL MATERIAL BALANCE FOR 15,000-TON PER YEAR HOUDRY BUTADIENE PLANT

Material	Per cent	
Fuel gas	23.6	
Catalyst deposit	9.5	(Burned in the process)
Butadiene	66.9	
	100.0	

Note: This material balance allows for losses in butane absorber and is based on 90 per cent recovery of the butadiene in the purification process.

TABLE 2 ESTIMATED COST, BASED ON ALL NEW MATERIAL, FOR A HOUDRY COMBINED TWO-STAGE DEHYDROGENATION AND SINGLE-STAGE PURIFICATION PLANT FOR PRODUCTION OF 15,000 TONS A YEAR OF BUTADIENE

1 Process plants	
(a) Dehydrogenation plant	$1,902,825
(b) Purification unit	955,000
(c) Auxiliaries; services and utilities	559,100
Total	$3,416,925
2 General administrative, purchasing, engineering, and development expense	225,000
3 Grand total	$3,641,925

[1] Chief Engineer, Sun Oil Company.
[2] Houdry Process Corporation.
[3] Consulting Engineer, Sun Oil Company. Mem. A.S.M.E.

equipment necessary to produce a given amount of butadiene.

Operating temperatures are relatively low so that the requirement for materials and expensive alloy steels is kept to a minimum. Likewise, utilities, as steam, fuel, power, and water required are low, and less material is needed for plant and equipment to supply them.

The equipment of the dehydrogenation unit for the production of butadiene is similar to that used in the existing Houdry catalytic plants. The reactors, or catalytic vessels, six in number, are of simpler design than in cracking plants.

The charging stock, butane, is subjected to dehydrogenating conditions in the reactors in two stages. The first stage yields butane, butylene, and lighter gas. The butane and butylene portion is concentrated in a vapor-recovery system to produce the charge for the second dehydrogenating stage in which the butadiene production is effected.

TABLE 5 ESTIMATED PRODUCTION COST FOR A HOUDRY COMBINED TWO-STAGE BUTADIENE PLANT TO PRODUCE 15,000 TONS PER YEAR, INCLUDING PURIFICATION PLANT

		Base price	Quantity per day	Cost per calendar day
1	Electric power	$0.007 Per kwhr	33600 Kwhr	$ 235
2	Fuel oil burned (6,000,000 Btu per bbl)	1.10 Bbl[a]	309 Bbls	340
3	Steam (from fuel or gas)	0.33 Per M lb	2040 M lb	673
4	Cooling water	0.008 Per M gal	10000 Gpm	115
5	Make-up water	0.15 Per M gal	300 Gpm	65
6	Operating labor:			
	Process plant, 10 men at $1.20 per hr			288
	Laboratory, 5 men at $1.20 per hr			144
	Undistributed labor and supervision			100
7	Catalyst			165
8	Solvent			216
9	Inhibitor			10
10	Maintenance (exclusive of boilerhouse and water system) 6 per cent of $3,036,420			500
11	Taxes, insurance, 1 per cent of $3,036,420			83
12	Total operating cost			$ 2934
13	Butane charge	$0.06 Gal 2.52 Bbl	677 Bbl	1706
14	Fuel-gas credit	1.10 Bbl	158 Bbl	174 (cr)
15	General administrative costs $0.075 per lb butadiene			684
16	Royalty at $0.00125 per lb butadiene			115
17	Total cost (exclusive of amortization)			5265
18	Cost of butadiene (exclusive of amortization) based on 66.9 per cent yield from butane, per lb			$0.06421

[a] Delivered in Texas or Oklahoma.

TABLE 3 MATERIAL REQUIREMENTS FOR HOUDRY COMBINED TWO-STEP DEHYDROGENATION AND PURIFICATION PLANT FOR PRODUCTION OF 15,000 TONS PER YEAR OF BUTADIENE

		Weight, tons		
		Dehydrogenation and separation unit	Purification unit	Total
1	Carbon-steel plate	293	250	543
2	Structural steel	484	143	627
3	Reinforcing steel	63	19	82
4	Steel tubular material	1015	360	1375
5	Steel forgings	68	38	106
6	Forged-steel valves	3	2	5
7	Cast-steel valves	234	38	272
8	Cast-steel castings	109	...	109
9	Carbon-steel bolts	10	3	13
	Total carbon steel	2279	853	3132
10	Cast-iron castings	42	34	76
11	Cast-iron castings (heat-resisting)	15	...	15
12	Cast-iron valves	25	13	38
	Total cast iron	82	47	129
13	27 per cent chrome-steel plate	30	...	30
14	Low-alloy steel bolts	10	3	13
15	Cast-brass valves	1	1	2
16	Brass tubing	19	...	19
17	Brass and bronze plates and bars	63	...	63
18	Copper cable and bars	16	...	16
19	Lead cable covering	6	2	8
	Total nonferrous materials	105	3	108
20	Machinery	465	60	525
	(Compressors, exclusive of refrigeration)	2450 Hp	470 Hp	2920 Hp
21	Electric motors, number	4	5	9
	(exclusive of refrigeration)	295 Hp	191 Hp	486 Hp
22	Transformers, number	2	...	2
23	Switch gear, number	2	...	2
24	Instruments and controls	9	3	12
25	Special equipment (cycle timer, etc.)	3	...	3
26	Insulation	375	125	500
27	Welding rod, alloy	3	...	3
28	Welding rod, carbon steel	24	8	32

NOTE: A 25 per cent addition has been made to all items for contingency.

TABLE 4 UTILITIES REQUIRED FOR A HOUDRY COMBINED TWO-STAGE BUTADIENE PLANT AND PURIFICATION PLANT TO PRODUCE 15,000 TONS PER YEAR.

Electric power, kwhr per day	33,600
Fuel oil or gas (80,200,000 Btu per hr) bbl per day	309
Steam, lb per day	2,040,000
Cooling-water circulation, gpm	10,000
Make-up water for cooling, gpm	300

NOTE: If process steam is first expanded through drivers the foregoing electric requirement may be correspondingly reduced.

The foregoing electric-power requirement includes refrigeration equipment. If steam- or gas-driven refrigeration compressors or steam-jet refrigeration be used, the power consumption may be reduced by 18,000 kwhr per day.

The heat required for the chemical change of butane to butylene and from butylene to butadiene is furnished by burning the carbon deposit on the catalyst during the dehydrogenating stages. The regeneration of the catalyst is accomplished by burning the carbon deposit by passing air through the catalyst. The reactors possess sufficient heat-storage capacity to eliminate wide temperature fluctuations, and pressure and rate of flow are regulated in such a manner as to balance the heat required for the chemical reactions with the heat supplied by the burning of the carbon deposit.

The Houdry process, so far as is known by the authors, is the only process which has developed the technique of utilizing the adiabatic cycle of heat produced during the burning cycle of the carbon as the principal source of heat required for the dehydrogenation cycle.

The separation and purification of butadiene may be effected by one of the available purification processes.

The high yield of butadiene obtained in the Houdry process, as shown in Table 1, is the result of its unique operating cycle.

Full details of the process cannot be given since secrecy orders issued by the U. S. Government preclude their disclosure, except when permits are obtained by persons or companies interested in the erection of plants to utilize the process.

The SUPERCHARGING *of* *Two-Stroke* DIESEL ENGINES[1]

By F. OEDERLIN

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THE supercharging of two-stroke Diesel engines has always been one of the most important aims in the development of the Diesel engine, and this more particularly since the four-stroke engine has successfully been supercharged, thereby greatly increasing its ability to compete. As early as 1912, the Sulzer two-stroke engine was built with "extra-charging." The principle of this process, which is assumed to be known, aimed at obtaining a supercharging effect. The air charge in the cylinder at the beginning of the compression stroke was of a higher density than had hitherto been generally used. The extra-charging pressure was limited, in accordance with the scavenging-air pressure, to the order of about 1.2 to 1.4 atm abs (17 to 20 psia), which, as compared with engines without extra-charging, gave an increased output of 10 to 30 per cent. This extra-charging pressure remained practically unchanged up to the present day and has been increased only in some special cases. The reason for this is that any further increase in the extra-charging pressure means an increase in the work absorbed by the scavenging pumps and, consequently, an increase in the fuel consumption. The latter is true as long as the energy of the exhaust gases, which increases with the extra-charging pressure, remains unutilized and therefore appears in the energy balance as a loss.

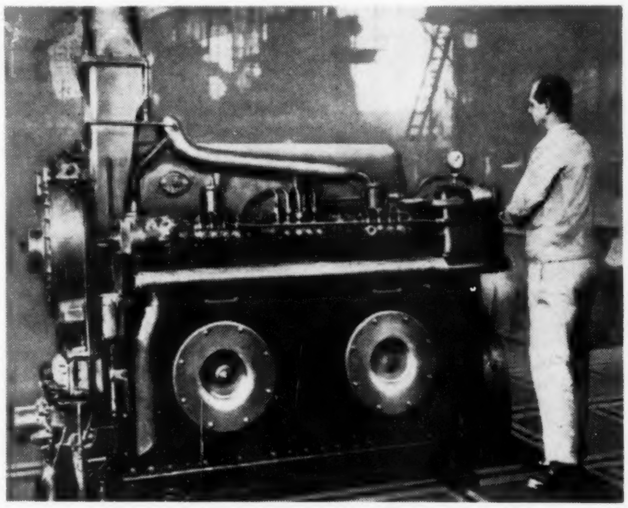


FIG. 1 VIEW SHOWING THE FIRST SUPERCHARGED, OPPOSED-PISTON, TWO-STROKE DIESEL ENGINE WITH COUPLED EXHAUST TURBINE, WITH WHICH A MEAN EFFECTIVE PRESSURE OF 12 KG PER SQ CM WAS REACHED

(Number of cylinders 4, bore 190 mm, stroke 2 × 300 mm; supercharging pressure 2 atm abs; 1-hour rating, 1370 bhp at 750 rpm, and 12 kg per sq cm mean effective pressure.)

The adoption of higher supercharging pressures therefore requires, particularly with respect to fuel consumption, utilization of the exhaust energy, that is to say, its conversion into useful mechanical energy. At present the best means for this is the exhaust-gas turbine.

UTILIZING THE EXHAUST-GAS TURBINE

The most evident solution would be to use the exhaust-gas turbine to drive a rotary compressor supplying scavenging and charging air and in this way to eliminate the scavenging pump. Unfortunately, it is not possible to realize this method of supercharging in practice, since only at high loads and high exhaust temperatures is the output of the exhaust-gas turbine sufficient for compressing the necessary amount of scavenging and charging air—at low loads the supply of air would be insufficient. The crux of the matter, however, is that the two-stroke engine, supercharged in such a manner, could not be started at all, since the exhaust-gas turbine driving the compressor speeds up too slowly after being started. Consequently, to supercharge the two-stroke engine, the energy which is required for the compressor when the engine starts and when it operates at low load must be supplied from outside.

It is possible, for instance, according to the Sulzer process here called "high supercharging," to adopt for this purpose a reciprocating scavenging-air pump, suitably strengthened and of such dimensions as to give the appropriate degree of supercharging, this pump being driven from the crankshaft and supplying the total quantity of air required. The energy developed in the exhaust-gas turbine must then, in order to be utilized, be transmitted to the crankshaft by gearing. The reciprocating scavenging-air pump may also be replaced by a rotary compressor which is driven directly or indirectly from the exhaust-gas turbine coupled to the crankshaft through gearing. In both cases, the compressor is driven by the Diesel engine right from the start, and it can supply immediately the necessary quantity of scavenging air. The supercharging pressure can, at least theoretically, be chosen as desired. The most efficacious supercharging pressure will vary, however, under the influence of various factors.

Investigations have shown that the indicated output of the exhaust-gas turbine is greater than the indicated power absorbed by the compressor. A positive area of indicated work is therefore available for the charging set. However, because of the unavoidable losses in the exhaust-gas turbine and compressor, the output of the turbine is sufficient to cover the power required by the compressor only in the case of large installations and when the load on the plant is high. Surplus power which may be available in the turbine is then transmitted to the crankshaft through the gearing already mentioned. But, even with engines of medium and small output, the power required by the compressor will be supplied in a large proportion by the exhaust-gas turbine. Under average conditions, it can be presumed that the power required for the compressor and the

[1] Extract from a paper by the author concerning development work in connection with the supercharging of two-stroke Diesel engines.

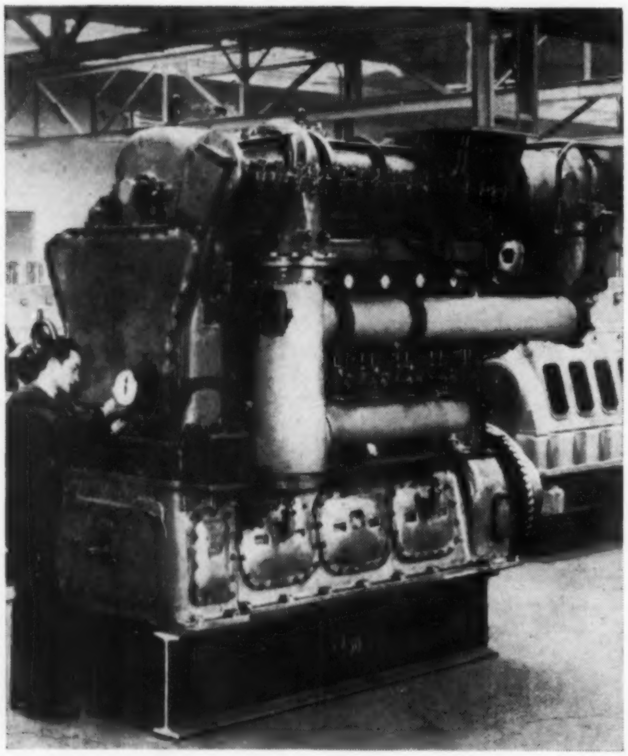


FIG. 2 TWO-STROKE, TWO-SHAFT, OPPOSED-PISTON DIESEL ENGINE
(Supercharged to 2 atm abs and developing 1560 bhp at 850 rpm in the Sulzer Works at Winterthur.)

output developed by the turbine will balance each other to a large extent.

TWO-STROKE HIGH SUPERCHARGING

Based on these considerations, Sulzer Brothers several years ago took up the practical realization of two-stroke high supercharging. First, a special experimental engine was built and submitted to thorough tests. These tests were originally confined to the Diesel engine alone. The influence of the exhaust-gas turbine was imitated by a throttle orifice. The air for scavenging and charging was taken from the compressed-air system in the works and heated up to the temperature corresponding to the polytropic compression of a normal compressor.

With this experimental engine supercharged to 2 atm (28 psia), a mean effective pressure of 12 kg per sq cm (170 psi) was attained with absolutely clear exhaust. This mean effective pressure could be maintained without any difficulty for a considerable length of time. During a special test undertaken later on another engine with the same supercharging pressure, a mean effective pressure of as much as 13 kg per sq cm (185 psi) was maintained for 48 hr. In comparison with the nonsupercharged two-stroke engine, the increase in mean effective pressure or in output was 100 per cent.

The same experimental engine was then operated with a supercharging pressure of 3 atm (43 psia), which allowed a mean effective pressure of 15 kg per sq cm (210 psi) to be reached, that could again be maintained as long as desired with the exhaust perfectly clear.

After the clearance space had been suitably enlarged, the same experimental engine was run with supercharging pressures which were gradually increased to 6 atm abs (85 psia), whereby the continuously permissible mean effective pressure could be raised to 18 kg per sq cm (255 psi).

Combustion takes place with a relatively large proportion of excess air and, at all loads, gives an absolutely invisible exhaust gas, the purity of which shows it to be an excellent medium for working an exhaust-gas turbine.

OPPOSED-PISTON ENGINE USING SUPERCHARGING SYSTEM

Based on the excellent results obtained with the experimental engine mentioned, an engine supercharged to 2 atm abs was built; in order to obtain an engine with as high an output per cubic inch displacement as possible, the opposed-piston type was adopted. The exhaust-gas turbine is overhung from the end of the exhaust manifold. Its output is transmitted to the crankshaft through gears. The scavenging and charging air is supplied by reciprocating compressors coupled to the crankshaft. The principal data of this engine are:

Number of cylinders	4
Bore	190 Mm (approx. 7.5 in.)
Stroke	2 × 300 Mm (approx. 2 × 11.8 in.)
Speed	750 Rpm
Piston speed	7.5 M per sec (1475 fpm)
1-Hour rating	1370 Bhp
Mean effective pressure at 1-hr rating, including turbine and compressor	12 Kg per sq cm (170 psi)
Fuel consumption	158 G per bhp-hr (0.35 lb per bhp-hr)

During industrial service in the Sulzer works for more than 3000 hr, it was found that the newly designed constructional elements complied in all respects with the stipulated conditions. The mechanical transmission of energy between exhaust turbine and crankshaft never gave rise to any trouble. Even during periods of severe cold, the engine always started easily and quickly. This Sulzer engine represents the first practically usable realization of a supercharged two-stroke engine with built-on exhaust-gas turbine to attain such high mean effective pressures.

In large installations, the mechanical coupling between the turbine and the crankshaft can be replaced by an electromagnetic or a hydraulic coupling. The transmission of energy may also be effected electrically, the supercharging set being driven by an electric motor receiving energy from the mains or from a separate generator.

SUPERCHARGING AT HIGHER SPEEDS

In order to determine the suitability of high supercharging at higher speeds, an experimental engine was built having cylinders of 120 mm (approximately 4.7 in.) bore and 2 × 150 mm (approximately 5.9 in.) stroke, and intended at first to run at 1500 rpm. This new design also easily reached the mean effective pressures of the former experimental engines, amounting to 12, 15, and 18 kg per sq cm with supercharging to 2, 3, and 6 atm abs, respectively. At 1500 rpm the fuel consumption was 180 to 190 g per bhp-hr (0.40 to 0.42 lb per bhp-hr), leaving out of consideration the turbine output and the power absorbed by the compressor which, as mentioned before, practically balance each other. Meanwhile, the speed has been raised to 2400 rpm, corresponding to a piston speed of 12 m per sec (2360 fpm).

In addition, tests were made on a single-piston engine of 420-mm ($16^1/_2$ in.) bore, where the supercharging was at first limited to 2 atm abs. These tests too showed that the output increases up to this limit practically in direct proportion to the degree of supercharging, thus confirming the results obtained in this field with engines of smaller bore.

Based on these results, Sulzer Brothers, Limited, has started gradually to adapt its single-piston-per-cylinder engines of medium and large bore to the requirements of two-stroke supercharging. Simultaneously, a new type of engine has been

developed, Fig. 2, allowing a far-reaching utilization of the possibilities offered by high supercharging. This engine, of the two-shaft opposed-piston type, has the following data:

Number of cylinders........	6
Bore........................	180 Mm (7.1 in.)
Stroke......................	2 × 225 Mm (2 × 8.8 in.)
Speed.......................	850 Rpm
Piston speed................	6.375 M per sec (1250 Fpm)
Supercharging pressure......	2 Atm abs (28 Psi)
Output, 1-hr rating.........	1560 Bhp

This engine is built in such a way that it can also be supercharged experimentally with 6 atm abs, thus raising its output to 2340 bhp and further reducing its specific weight.

Supercharging to 5 or 6 atm abs (70 to 85 psi) represents a peculiar case, in that within this range of supercharging, the power delivered by the Diesel engine and the power absorbed by the supercharging compressor become equal. The effective output of the entire plant thus corresponds essentially to the output of the exhaust-gas turbine. The turbine may, therefore, be uncoupled from the Diesel engine and from the compressor without the energy balance of the whole set being thereby disturbed. The set, comprising Diesel engine and compressor, here designated "power-gas generator," fulfills the same purpose as, for instance, a boiler in a steam power station. The entire effective output is given up by the power gas turbine which corresponds to the steam turbine of the steam-power station. Accordingly several power gas generators can be arranged to work on one common power gas turbine.

FREE-PISTON POWER-GAS GENERATORS

This power-generating process can also be accomplished by means of free-piston power gas generators. With power gas generators of this kind, each of the opposed pistons of the Diesel part works directly on a compressor piston which compresses the scavenging and charging air. No crankshaft is provided. The two pistons are merely coupled to each other by a linkage which insures their running symmetrically. The volume of the clearance space adjusts itself automatically to suit the supercharging pressure used at the moment.

The power-gas process represents a possible realization of the "gas turbine." A particularly remarkable feature is the high thermal efficiency of 35 to 40 per cent, without adopting any recuperators or similar apparatus and at service temperatures of only 450 to 500 C (840 to 935 F). The power-gas turbines are small and simple. The reliability in service of the whole plant is increased by the independence of the individual power-gas generators. Critical speeds are not to be feared, since the separate power-gas generators are coupled to each other only by a very flexible gas column. With the power-gas process, outputs may be obtained which hitherto were beyond the range covered by the Diesel engine, and with specific weights corresponding to those of the lightest steam installations.

The power-gas process has been thoroughly studied theoretically and practically by Sulzer Brothers in both variants: with crankshaft and with free-piston power-gas generators.

The supercharging pressure may be increased beyond 6 atm abs. With the power-gas process, however, the exhaust-gas-turbine output must be drawn upon in this case for the compression work, since the power required by the compressor exceeds the power developed by the Diesel engine.

ARRANGEMENT OF TYPICAL SUPERCHARGED UNITS

Figs. 3, 4, 5, and 6 give some idea of the space requirements and the general layout resulting from the adoption of supercharged two-stroke Diesel engines.

Fig. 4 shows a stationary power plant of 7000 bhp, comprising two supercharged, two-stroke, two-shaft, opposed-piston engines with one common electric generator. Scavenging and charging air is supplied by an axial compressor consisting of a high- and a low-pressure part with an air cooler arranged between them, the compressor being driven by an exhaust-gas turbine. The energy, which the latter cannot supply when starting and at low loads, is obtained from an electric motor connected to the power system of the works and running idle when the Diesel engines are working at full load.

Fig. 5 illustrates the Diesel-electric machinery of a large motorship of 37,500 shp. This plant comprises 10 two-stroke, two-shaft, opposed-piston, electric generator sets, of which 9 are available for supplying the propelling energy required at full load, while one is used for supplying electricity for general service. The scavenging and charging air is supplied by reciprocating compressors driven directly from the crankshafts. The energy delivered by the electric generators is used to drive two propulsion motors, each developing 18,750 bhp at 130 rpm.

In the case of the plant shown in Fig. 5, reversibility is insured by the electric transmission in the usual way. The highly supercharged two-stroke engine can, however, be also direct-reversed by separating the supercharging set from the Diesel engine and getting from an auxiliary electric motor energy still lacking when starting and at low loads, as is the case in the plant illustrated in Fig. 4. Another possibility consists in adopting reciprocating compressors to supply the scavenging and charging air, and to connect the exhaust-gas turbine to the engine through a clutch coupling. A promising solution of the reversing problem is also represented by the reversible propeller, the blades of which can be inverted while the plant is running, thus making it possible to reverse the vessel without changing the direction of rotation of the engines.

Fig. 6 represents a marine plant of 3900 shp with a horizontally arranged supercharged, two-stroke, two-shaft, opposed-piston Diesel engine which can be reversed directly in the usual manner. The large wheel of the synchronizing gear serves at the same time as a reducing gear, driving at 112 rpm

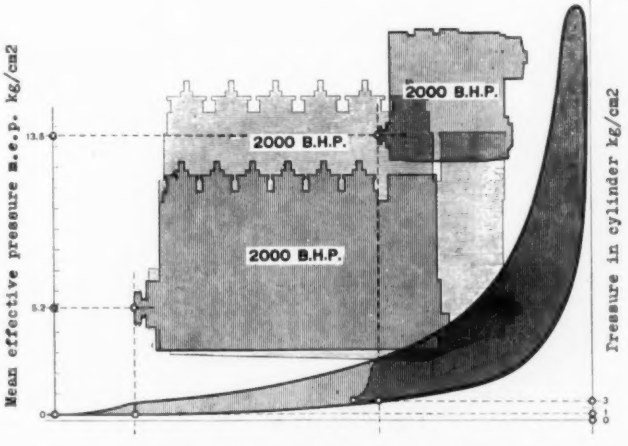
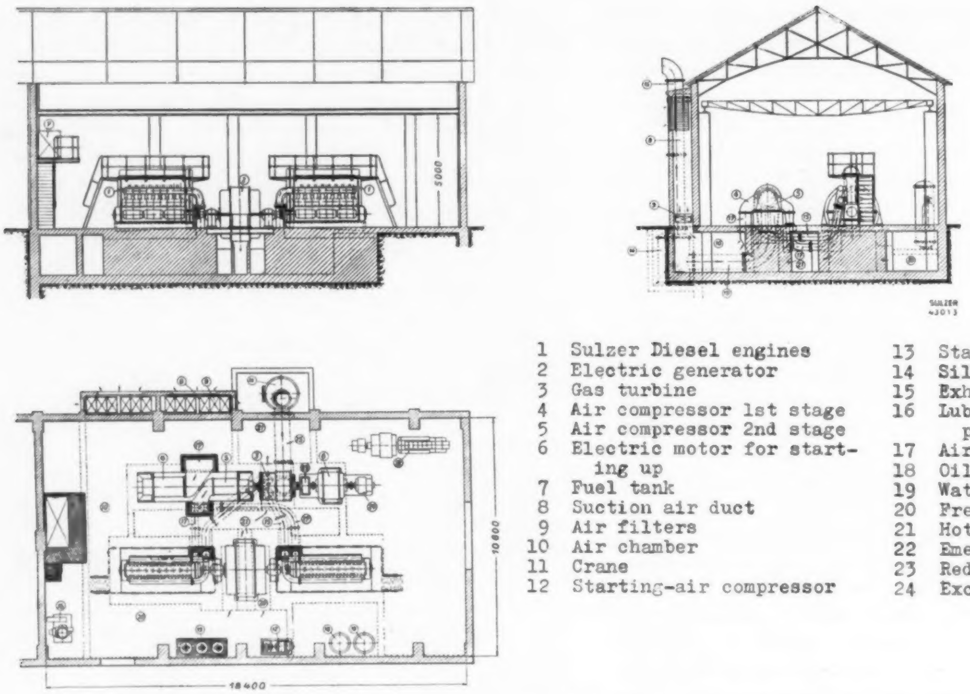


FIG. 3 COMPARISON BETWEEN SPACE REQUIRED BY: A NONSUPERCHARGED, 2000-BHP, TWO-STROKE DIESEL ENGINE WITH CROSSHEAD; A NONSUPERCHARGED, 2000-BHP, TRUNK-PISTON, TWO-STROKE DIESEL ENGINE; AND A 2000-BHP, TWO-STROKE, OPPOSED-PISTON DIESEL ENGINE, SUPERCHARGED ACCORDING TO THE SULZER PROCESS

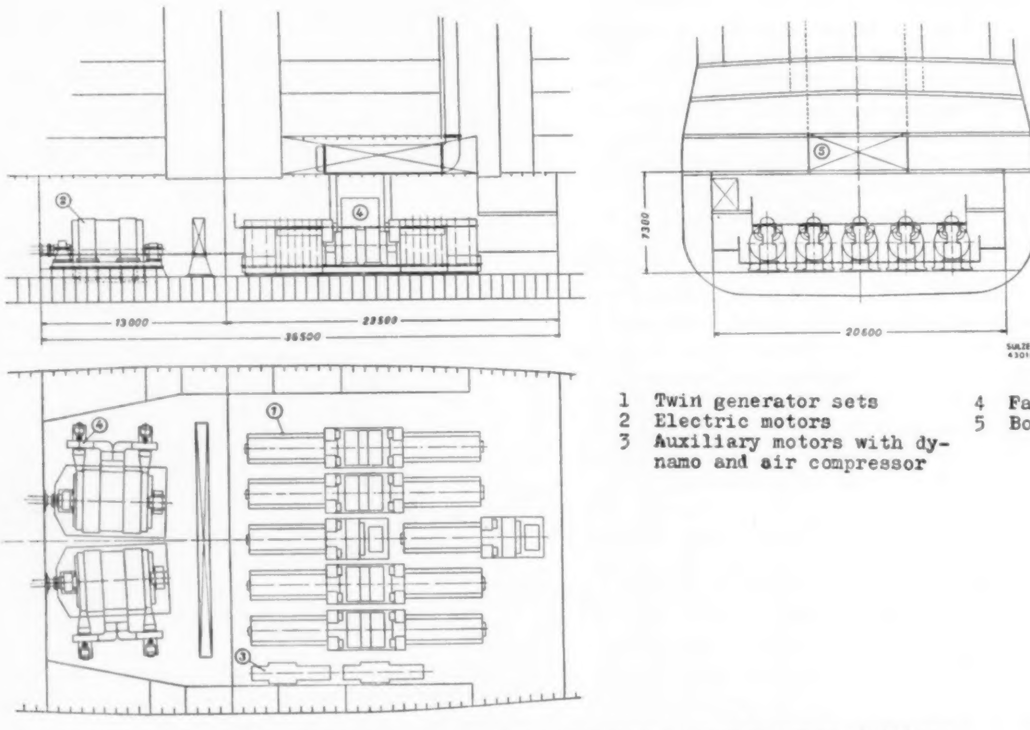
(The darker indicator diagram of the supercharged engine shows the work done in the Diesel cylinders. The work resulting from the exhaust-gas turbine and the supercharging compressor is, as regards area, almost identical with the lighter crosshatched lower diagram area of the nonsupercharged engine.)



1 Sulzer Diesel engines
2 Electric generator
3 Gas turbine
4 Air compressor 1st stage
5 Air compressor 2nd stage
6 Electric motor for starting up
7 Fuel tank
8 Suction air duct
9 Air filters
10 Air chamber
11 Crane
12 Starting-air compressor
13 Starting-air bottles
14 Silencer
15 Exhaust pipes
16 Lubricating oil separator
17 Air pipes
18 Oil cooler
19 Water cooler
20 Fresh air duct
21 Hot air duct
22 Emergency set
23 Reduction gear
24 Exciter

FIG. 4 LAYOUT OF A STATIONARY POWER PLANT OF 7000 BHP WITH TWO SUPERCHARGED TWO-SHAFT ENGINES AND SEPARATE CHARGING SET

(The Diesel engines, coupled to one electric generator, have 9 cylinders of 180 mm bore and 2 × 225 mm stroke. When supercharged to 3.5 atm abs and running at 1000 rpm, the mean effective pressure at full load is 15.3 kg per sq cm and the output 3500 bhp per engine.)



1 Twin generator sets
2 Electric motors
3 Auxiliary motors with dynamo and air compressor
4 Fan
5 Boiler plant

FIG. 5 SPACE REQUIRED BY A DIESEL-ELECTRIC MARINE PLANT OF 37,500 SHP

(The plant comprises 10 two-shaft generating sets, of which 9 are used for propulsion and 1 for providing electricity for general use. Each engine has 6 cylinders of 320 mm bore and 2 × 400 mm stroke. At the service speed of 450 rpm and with a charging pressure of 2.5 atm abs, the mean effective pressure is 12.1 kg per sq cm.)

the propeller shaft coupled to it. The exhaust-gas turbine drives the large wheel through a hydraulic coupling and a countershaft. When the vessel is moving astern, the hydraulic coupling is disengaged by emptying it.

PRACTICAL CONSIDERATION OF QUALITIES

The highly supercharged two-stroke Diesel engine will, in the first place, be employed where stricter requirements with regard to weight of the power plant and space it occupies have to be complied with as, for instance in traction, in certain kinds of ships, and, in general, in plants intended for taking peak loads or serving as stand-by.

The supercharging set of the supercharged two-stroke engine may be regarded as a constant-pressure gas turbine, i.e., a gas turbine with continuous combustion, the combustion chamber of which is replaced by a supercharged Diesel engine. The supercharging set has, as in the case of the gas turbine, an indicated output of positive value. While, in the case of the gas turbine, only the difference between the output of the turbine and the power absorbed by the compressor appears as effective output, this is increased, with high supercharging, by the output obtained from the Diesel engine. Its effect appears clearly in the thermal efficiency, which is of the order of about 40 per cent with high supercharging, while it amounts to about 18 per cent with the simple gas turbine.

Replacing the combustion chamber of the gas turbine by a Diesel engine is also justified with respect to the heat load, since it is in any case necessary to cool the hot gases from their initial temperature of 1500 to 2000 C (2700 to 3600 F), to about 500 to 600 C (900 to 1100 F), before admitting them to the exhaust-gas turbine. Instead of effecting this cooling by admixture of excess air, as is the case in the gas turbine, this cooling takes place in the supercharged Diesel engine, mostly through adiabatic expansion of the gases in the Diesel cylinders, where they at the same time perform useful work.

When the supercharging pressure of the Diesel engine is further increased, the swept volume becomes smaller and smaller, the clearance remaining the same. In the limiting case, the swept volume becomes zero, and the Diesel engine is then reduced to nothing but clearance space. This clearance space is then identical with the combustion chamber of the hypothetical high-pressure gas turbine, which because of its high working temperatures can at present not yet be realized. On the other hand, this working process can, as has been shown, be carried out with good efficiency in the supercharged Diesel or in the power gas plant.

Also, from a constructional point of view, it is logical to place the combustion process and the higher compression and expansion pressures into the Diesel cylinder, this being the most suitable structural element therefor. Since, however, the swept volume of the Diesel engine is an important factor in the cost of the whole power plant and is only poorly utilized in the lower part of the indicator diagram, it is again logical, as far as it is possible to do so, to confide this part of the compression and expansion work to radial or axial compressors and to turbines, which, as is well known, are cheaper, lighter and smaller, and have proved especially well suited for handling large quantities of gases at low and medium pressures.

CONCLUSIONS

From these considerations and the results obtained, it can be concluded that there are important reasons in favor of this combination of the Diesel engine and the gas turbine. It offers an increase in thermal efficiency of more than 100 per cent, as compared with the gas turbine, and an increase in mean effective pressure of 100 to 200 per cent, as compared with the nonsupercharged Diesel engine.

Nevertheless, the gas turbine should acquire importance as well as the power-gas process, especially in fields where units of great power are needed, provided that its efficiency, at full load and particularly at part load, can be considerably improved. For this reason Sulzer Brothers, Ltd., has devoted much attention to the gas turbine and has at length taken up the realization of a gas turbine of its own design. The gas turbine will not be able to replace the Diesel engine, whether supercharged or not, since the latter can still claim to have the highest thermal efficiency of any form of thermal prime mover, and it will maintain this superiority also in face of the gas turbine.

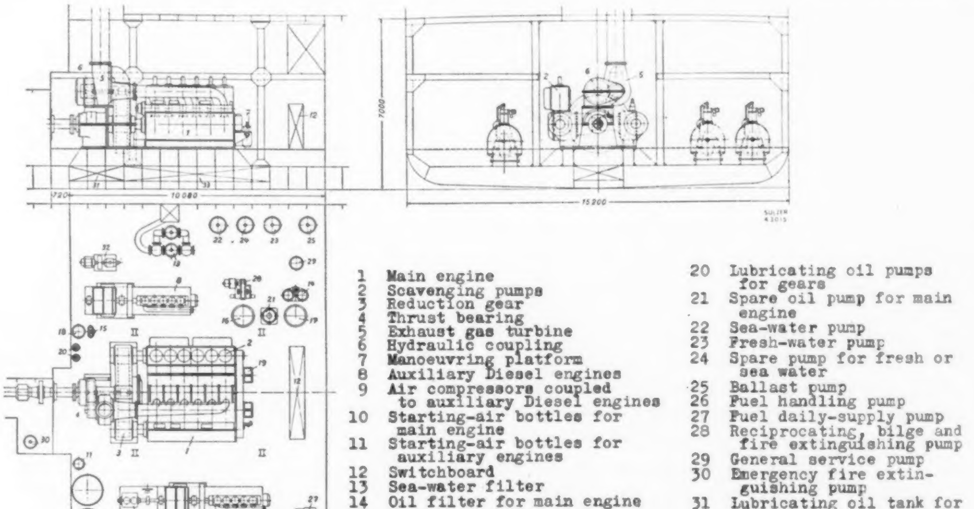


FIG. 6 MARINE INSTALLATION OF 3900 SHP

(The horizontally arranged two-stroke, two-shaft, opposed-piston engine comprises 6 cylinders of 320 mm bore and 2 × 400 mm stroke. At 448 rpm, with a charging pressure of 2 atm abs, the mean effective pressure is 10 kg per sq cm. The synchronizing gear is designed as reduction gear and with the large wheel drives the propeller shaft at 112 rpm. The scavenging and charging air is here supplied by reciprocating scavenging pumps; it could be supplied by rotary blowers. The exhaust-gas turbine works on the large wheel of the synchronizing gear through a hydraulic coupling.)

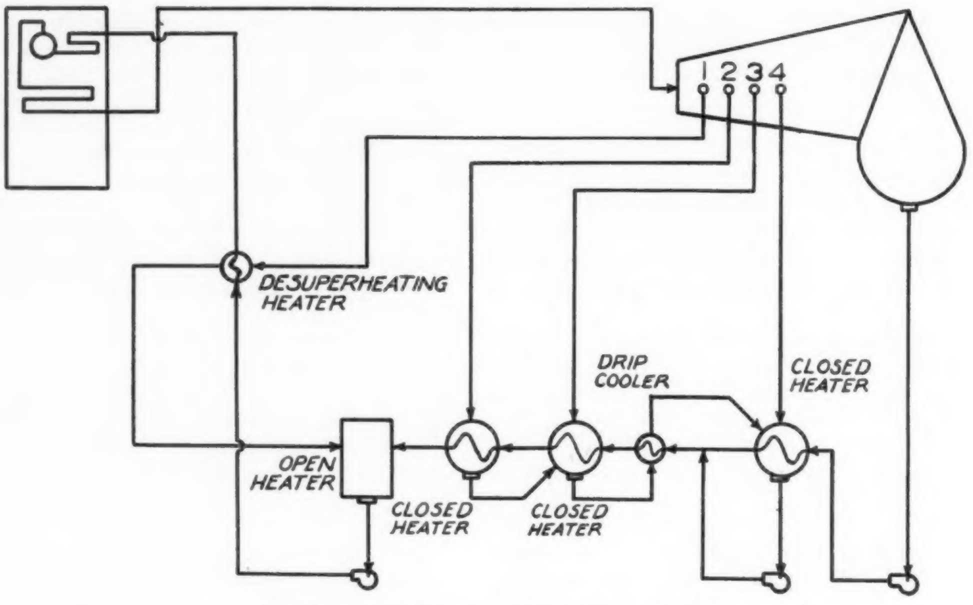


FIG. 1 FLOW DIAGRAM FOR TYPICAL PLANT
(Plant symbol, (D)OCC$_o$ $\underline{C}$.)

Comparison of POWER-PLANT HEATER ARRANGEMENTS

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THE purpose of this investigation is to ascertain the heat rates of power plants with three and four extraction points and various heater arrangements. The variations studied are: (1) Open heaters versus closed heaters. (2) Use of desuperheating heater for the high-pressure extraction steam. (3) Cascading drip of closed heaters to lower pressures versus pumping it to higher pressures. (4) Use of drip coolers when drips are cascaded to lower pressures.

BASIS OF COMPARISON

All plants operate with the same steam conditions of 864.7 psia and 900 F at the throttle and 1.4 in. Hg back pressure. Steam conditions at the bleed points for plants with four extraction points are those of a recently installed plant. A list of corresponding enthalpy and pressure values for the turbine-condition curve of this plant is given in Table 1. Plants having three extraction points operate with this same condition curve; the bleed-point pressures for these plants are those of another recent installation which has the same throttle conditions and condenser pressure. The final feedwater temperature for both three- and four-extraction-point plants is in the vicinity of the optimum final feed temperature.[1]

The choice of pressure drops from bleed points to heaters was governed by representative operating conditions. Table 2 gives the bleed-point pressures and enthalpies, pressure drops, and heater pressures for all plants. The pressure drop across the

[1] "Mechanical Engineers' Handbook," edited by Lionel S. Marks, fourth edition, McGraw-Hill Book Company, Inc., New York, N. Y., 1941, p. 1238.

TABLE 1 CONDITION-CURVE DATA

Enthalpy, Btu per lb	Pressure, psia
1453.1	864.7
1340.0	212.0
1300.0	140.0
1250.0	78.5
1200.0	41.7
1150.0	19.2
1100.0	8.50
1050.0	3.40
1000.0	1.21
974.5	0.688
982.2[a]	0.688

[a] Includes leaving loss.

TABLE 2 TABULATION OF BASIC VALUES

	Bleed point	Bleed point pressure, psia	ΔP psi	Heater pressure, psia	h Btu per lb
Three bleed points	T	864.7	..	..	1453.1
	1	179.5	5.5	174.0	1323.0
	2	64.5	2.5	62.0	1234.0
	3	13.14	1.14	12.0	1124.0
	C	0.688	..	..	982.2
Four bleed points	T	864.7	..	..	1453.1
	1	173.0	5.0	168.0	1319.0
	2	97.0	3.0	94.0	1267.0
	3	35.2	1.2	34.0	1190.0
	4	7.52	0.52	7.00	1093.0
	C	0.688	..	..	982.2

T = throttle
1 = first bleed point
2 = second bleed point
3 = third bleed point
4 = fourth bleed point
C = entrance to condenser
ΔP = pressure drop between extraction point and heater
h = enthalpy at extraction point
NOTE: h_c includes leaving kinetic energy.

TABLE 3 TABULATION OF RESULTS

Plant no.	Plant symbol	Number of bleed points	Heat rate, Btu per kwhr	ω_T lb per hr	ω_1 lb per hr	ω_2 lb per hr	ω_3 lb per hr	ω_4 lb per hr	ω_c lb per hr
1	(D)OOOO	4	9311	335,600	16,210	20,750	23,270	23,270	252,100
2	OOOO	4	9318	334,850	15,140	20,770	23,290	23,290	252,360
3	(D)OC$_\circ$ $\underline{C}$O[a]	4	9318	336,050	18,050	20,400	21,810	23,220	252,570
4	CCCC	4	9343	334,260	14,960	20,600	23,130	22,010	253,560
5	CCCC	4	9345	334,270	15,590	19,860	23,140	22,020	253,660
6	CCOC[a]	4	9352	334,510	15,800	20,790	22,060	22,060	253,800
7	CCCC	4	9354	334,690	14,980	20,740	24,990	19,910	254,070
8	CCC$_\circ$C	4	9357	334,710	15,800	22,460	20,260	21,990	254,200
9	CCCC$_\circ$[a]	4	9359	334,750	15,850	22,150	20,620	22,150	253,980
10	(D)OOO	3	9361	339,500	27,570	27,670	30,020	..	254,240
11	(D)O$\underline{C}$O[a]	3	9367	339,910	29,160	26,220	30,140	..	254,390
12	OOO	3	9375	337,840	25,190	27,740	30,090	..	254,820
13	CCCC	4	9386	335,720	15,840	22,530	25,210	16,710	255,430
14	(D)CO$\underline{C}$	3	9388	338,960	27,990	26,720	28,880	..	255,370
15	C$_\circ$OC[a]	3	9391	336,830	23,500	28,860	28,810	..	255,660
16	COO[a]	3	9392	336,870	25,270	25,760	30,190	..	255,650
17	CO$\underline{C}$[a]	3	9402	337,230	25,400	26,970	28,940	..	255,920
18	...	0	10,317	295,710	..	..	..	..	295,710

[a] Heater arrangement is that of an actual power plant.
NOTE:
All plants deliver 40,000 kw at generator terminals.
Heat rates are based on generator output.
Heat rates are accurate to 2 Btu per kwhr.
Mass flows are accurate to 100 lb per hr.

ω_T = mass rate of flow to throttle.
ω_1 = mass rate of flow from first bleed point.
ω_2 = mass rate of flow from second bleed point.
ω_3 = mass rate of flow from third bleed point.
ω_4 = mass rate of flow from fourth bleed point.
ω_c = mass rate of flow to condenser.

steam side of a desuperheating heater was taken as 4 psi. Terminal-temperature differences of 5 F were assumed for all closed heaters. A desuperheating heater was assumed to cool the steam to a state of 20 deg superheat. Drip coolers were assumed to cool the drip to a temperature of 5 F above the temperature of the entering condensate. The drip from closed heaters and the condensate leaving open heaters were assumed to be saturated liquid. The sum of the bearing losses and generator losses was taken as 800 kw at 40,000 kw generator output.

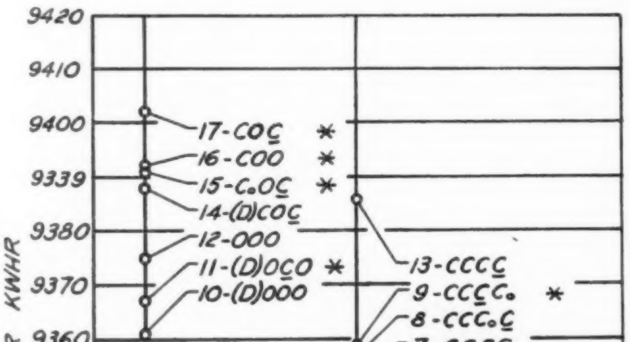


FIG. 2 COMPARISON OF HEAT RATES FOR VARIOUS HEATER ARRANGEMENTS

To simplify computations and in order not to lose track of the fundamental purpose of this investigation, the following items were neglected: (1) Boiler blowdown; (2) gland leakage; (3) all steam losses to soot blowers, fireless locomotives, etc.; (4) steam used by air ejectors; (5) enthalpy increase of condensate in air-ejector condensers, oil coolers, air or hydrogen coolers, and pumps; (6) changes in elevation, differences in kinetic energy (other than leaving loss of turbine); (7) heat losses; (8) auxiliary power.

EXPLANATION OF SYMBOLS

The system of symbols employed indicates the heater arrangement without the aid of flow diagrams. The symbol (D) indicates that the steam from the first extraction point passes through a desuperheating heater before entering the first-point heater. The letter O symbolizes an open heater and C a closed heater. The order in which the letters O and C appear corresponds to the order of the bleed points from which the heaters receive their heating steam. The underlining in $\underline{C}$ indicates that the drip of the closed heater is pumped into the condensate stream which has just left this heater, while plain C indicates that the drip is cascaded into the next lower pressure heater. The circle in C$_\circ$ symbolizes a drip cooler through which the drip passes before entering the next lower pressure heater. As an example, Fig. 1 shows a flow diagram for a plant bearing the symbol (D)OCC$_\circ\underline{C}$.

RESULTS

For each plant studied there were computed the heat rate and the various mass rates of flow, for a generator output of 40,000 kw. These results are in Table 3, which gives the plants in order of increasing heat rate. Fig. 2, which is a graphical presentation of the results, shows the heat rate and the number of extraction points for each plant.

Computed mass rates of flow are accurate to 100 lb per hr, and heat rates are accurate to 2 Btu per kwhr.

DISCUSSION OF RESULTS

Comparison of the heat rates for a pair of plants which differ in only one respect will indicate the effect of the single variable involved. For instance, comparison of plant 16 with plant 12

Plant 16	COO	9392 Btu per kwhr
Plant 12	OOO	9375 Btu per kwhr

shows that the replacement of a first-point open heater by a first-point closed heater, the drip of which is cascaded to lower pressures, results in an increase in heat rate of 17 Btu per kwhr, other things remaining the same. Comparison of plant 4 with plant 13

Plant 4	CCCC	9343 Btu per kwhr
Plant 13	CCCC	9386 Btu per kwhr

shows that a saving of 43 Btu per kwhr results if the drips from all closed heaters are pumped up to higher pressures rather than cascaded cumulatively into the lowest pressure heater.

In making comparisons of this sort, it must be remembered that the numerical results apply only for the specific conditions mentioned under "Basis of Comparison." However, it is probable that the same relative results would be obtained for different conditions, provided that they are reasonably chosen. Particular caution should be taken in comparing plants which have different numbers of bleed points, since the choice of bleed pressures may have an important bearing on the results.

The following general conclusions concerning heat rates may be drawn:

1 Open heaters are better than closed heaters. Compare:

Plant 2	OOOO	9318 Btu per kwhr
Plant 4	CCCC	9343 Btu per kwhr
Plant 10	(D)OOO	9361 Btu per kwhr
Plant 11	(D)OCO	9367 Btu per kwhr
Plant 16	COO	9392 Btu per kwhr
Plant 17	COC	9402 Btu per kwhr
Plant 6	CCOC	9352 Btu per kwhr
Plant 13	CCCC	9386 Btu per kwhr
Plant 12	OOO	9375 Btu per kwhr
Plant 16	COO	9392 Btu per kwhr

2 A desuperheating heater for the first-bleed-point steam results in a saving of approximately 14 Btu per kwhr for three bleed points, and 7 Btu per kwhr for four bleed points. The magnitudes involved here are dependent to a great extent on the superheat at the first bleed point, and the pressure drop across the desuperheating heater. Compare:

Plant 10	(D)OOO	9361 Btu per kwhr
Plant 12	OOO	9375 Btu per kwhr
Plant 14	(D)COC	9388 Btu per kwhr
Plant 17	COC	9402 Btu per kwhr
Plant 1	(D)OOOO	9311 Btu per kwhr
Plant 2	OOOO	9318 Btu per kwhr

3 Regarding the disposal of the drip from closed heaters, pumping to higher pressures is best, cascading to the next lower pressure heater through a drip cooler is next best, and cascading directly into the next lower pressure heater is worst. Compare:

Plant 4	CCCC	9343 Btu per kwhr
Plant 5	CCCC	9345 Btu per kwhr
Plant 4	CCCC	9343 Btu per kwhr
Plant 7	CCCC	9354 Btu per kwhr
Plant 8	CCC_oC	9357 Btu per kwhr
Plant 13	CCCC	9386 Btu per kwhr
Plant 15	C_oOC	9391 Btu per kwhr
Plant 17	COC	9402 Btu per kwhr

4 Cascading the drip cumulatively through several closed heaters magnifies the deleterious effect of cascading the drip down rather than pumping it up. Compare:

Plant 4	CCCC	9343 Btu per kwhr
Plant 5	CCCC	9345 Btu per kwhr
Plant 13	CCCC	9386 Btu per kwhr
Plant 4	CCCC	9343 Btu per kwhr
Plant 7	CCCC	9354 Btu per kwhr
Plant 13	CCCC	9386 Btu per kwhr

Coal Follows Through

(*Continued from page 772*)

with a definitely known supply of about 13 years, and which should be under option for the specific use of automobile, aviation, Navy and ocean-going vessels, is not the most conservative judgment, to say the least.

I am fearful we have been soft in our ways of looking at many of our day-to-day problems, not realizing what the problems of tomorrow might be. Those engaged in the coal industry in the past and possibly at present have been responsible for this condition, at least in some considerable measure, through their lack of foresight as to what was good for the users of fuel, as well as for their industry.

So much for the state of affairs in which we find ourselves. What shall we do now to best prepare for what may be a much more acute situation than we have even yet contemplated?

1 While there are shortages of many materials and equipment needed for the conventional methods for conversion from oil to coal, there should be no shortage of brains and applied effort on the part of those who have spent years studying combustion and the uses of coal and looking for the place and opportunity to use their knowledge. It takes very little critical material for full-sized working experiments, and our Government has been helpful in permitting and, if need be, in promoting projects of merit when properly planned.

2 Coal producers should maintain quality of fuel for maximum economy, considering cost of production, freight, and handling; their agents should see that fuel is distributed to users where it is best fitted to their handling and burning equipment.

3 Every one responsible for the storage, handling, and burning of any fuel should be alert and diligent in obtaining the required output at the maximum obtainable efficiency.

4 Cleanliness, both as to coal dust and smoke, should be exercised now more than ever. It is economical, it is foresighted to keep as clean as possible with coal.

5 Most important of all is to have enough good coal available at every place of use when needed, so that our railroads will not falter nor any defense plant slow down for lack of power. So far you have done a good job, let us not stop to boast—let us do still better.

PHOTOGRAPHIC TEMPLATES

By E. C. JEWETT and C. D. TATE

EASTMAN KODAK COMPANY, ROCHESTER, N. Y.

IN THE development of large-scale production of nearly all types of machines, the transposition of engineering and design information from the drawings to the metal machine part itself or to the templates to be used in the manufacture of the part is a step requiring many hours of a skilled workman's time. It is also a source of possible error, particularly in the case of the more complex parts, requiring the location of many arc centers and noncircular mathematical curves. Where the product in question is formed from flat stock, templates of metal or other sheet material are extensively used.

A striking example of this is found in aircraft production where thousands of planes may be built from one model. In the design of a new plane, a lofting procedure, similar to that used in the construction of ships, is necessary. With the general form, the tentative lines, and the stress-bearing structure determined by the aeronautical designer, the plane is drawn to full scale on the loft floor. Many sections are drawn and the outlines adjusted or "faired" to insure smooth transition of form throughout the airplane surface. From this layout, detail drawings are prepared. To avoid dimensional changes, these drawings are made on sheet metal previously sprayed with a white lacquer. Care is taken to see that the delineation is within the required tolerance of the finished part. From these drawings, templates are made. These templates should carry all information concerning the part to be made, its contours, necessary drilling, location and degree of bending, etc.

In airplane production, several templates may be required for each part, and several copies of each template may be necessary where a number of production lines are occupied on the same model. For example, contour templates, jig templates, bending templates, and checking templates may be required. For a single airplane model, 25,000 templates may be used. To lay out these templates by hand would be a prodigious task, giving rise to frequent errors and delaying for months the starting of actual production. To overcome this difficulty, many suggestions have been made both for photographic and nonphotographic methods. Nonphotographic methods may require special drafting techniques and have other limitations which, in general, make them undesirable.

PHOTOCOPYING DIRECTLY ON TEMPLATES

Photocopying methods have long been used for the production of tracings, blueprints, photostats, engraving plates, etc. The large dimensional changes in paper or film base, caused by varying relative humidity, have prevented the use of these materials in the construction of templates. In order to use photography directly, it is necessary to photosensitize the template material itself.

The most direct procedure would be to coat the sheet material as paper and film base are coated. This presents many difficulties, however. If the sheet is coated by the photographic-goods manufacturer there are serious problems of light-tight packaging, storage, and transportation of large sensitized sheets. The sizes needed and the difficulty of predicting accurately, some weeks in advance, the quantities of each required would necessitate providing a large sheet storage in the user's factory. Some of these difficulties would be overcome if the liquid emulsion were coated on the sheet material by the user, but a host of new ones would arise. Emulsion performance is affected by many things, such as temperatures of emulsion and base material at coating, uniformity of thickness of coating, rate of drying, age of the emulsion, and cleanliness of the coating process. There is also a real problem in insuring a firm dependable bond between the base material and the emulsion layer which will withstand cracking and peeling throughout the required life of the template. All of these difficulties have been met by the development of "matte transfer paper," which consists of a projection-speed emulsion coated on a temporary paper base at the photographic factory and shipped in long rolls to the user. As it is required, this material is cemented, with the emulsion side in contact, to a previously prepared sheet of template stock by a very simple process. When the laminating cement is sufficiently cured, the paper base is stripped away leaving a firmly adhering photosensitized coating on the sheet material. The process is rapid and neat and, with reasonable care, completely satisfactory material is obtained.

REQUIREMENTS FOR REPRODUCING DRAWINGS

A satisfactory system of reproducing drawings must fulfill three requirements:

1 Exact dimensions must be preserved in the copy. Tolerances of 0.001 in. per ft may be required.

2 The draftsman's lines in the original copy must be faithfully reproduced. They should not become thickened, broken, or distorted in the copy.

3 Photosensitive materials used should be readily applicable to soft-body steel, galvaneal, aluminum, terne plate, plywood, or any other sheet material to which a drawing might be transferred. The bond should withstand subsequent shop operations necessary in fabrication.

In addition to the foregoing, it is desirable that the process should be simple, easy to operate, and rapid. Both right and mirror images may be required. Increase or decrease in scale is often desirable. Materials used should be readily available and economical. Processes should be of such a nature that adequate illumination is permissible. Tracings should be made by the same process.

Present processes do not satisfy all these requirements completely, but they have proved sufficiently valuable to obtain widespread acceptance. They are being continually improved and their scope widened.

PROJECTION METHODS

When drawings are transferred by projection methods, the original drawing is made full scale on a lacquered-metal drawing board using either pencil or ink, the lines being about 0.005 in. thick. With a suitable camera, a reduced-size negative on a glass plate is made from each drawing. A reduction to one-fourth or one-fifth size has been found most practical. The negatives thus obtained can be projected to full scale or to any desired scale onto sensitized tracing cloth, sheet metal, or plywood by means of the same camera. The relative positions of negative, sensitized plate, and lens govern the size ratio.

Contributed by the Production Engineering Division and presented at the Fall Meeting, Rochester, N. Y., October 12–14, 1942, of The American Society of Mechanical Engineers.

The surface of the metal or plywood must be photographically sensitized with a well-bonded layer. The exposed sheet is developed and fixed in the usual manner, yielding a true image positive print. With proper camera construction, installation, and proper care, reproductions will duplicate the size of the original within very close limits.

The chief requirement of the projection method lies in equipment which gives easy, accurate control of dimensions. A good process lens is satisfactory for normal work, 30-in. focal length probably being most suitable. This allows 5-ft × 10-ft sheets to be photographed at 5:1 reduction, which is not so large that an excessively long camera is required. More important perhaps than the lens is its perfect positioning with respect to the copy board and negative, which calls for a somewhat elaborate camera with an adequate calibration of copy board and negative distances. The process has greatest versatility because it allows for expansion or reduction in size. Thus, it is possible to allow for the shrinkage in the mold when shrink layouts are made for castings. Scale can be reduced so that models can be rapidly made for trial in the wind tunnel. With sensitized tracing cloth, reduced-scale blueprints are readily made for shop or other use, allowing an economy in blueprint paper. This versatility makes a camera almost a necessity in any completely equipped photographic department, in spite of the care required in its operation, the difficulty at the present time in obtaining cameras, and their cost—approximately $15,000 for the best quality.

To insure accurate reproduction of drawings, it is necessary to observe great care in the construction and installation of the camera. Negative holder, lens, and copy board must be held parallel to very close limits and all three units should be positioned from the same structural member. The entire structure should be suspended or supported in such a manner that building vibrations or like disturbances will not cause relative motion between the camera and the copy board. In a camera which has given satisfactory service, the structure carrying the three elements is built about a steel tube having an outside diameter of 14 in. This is supported from pipe columns.

The copy board for photographic-template work should be of the vacuum type in order to insure holding the metal drawing board and the sensitized metal plate in the focal plane. Maximum deviation of 0.002 in. of the copy-board surface from a true plane has been found satisfactory. Fairly small departures from the plane would probably remain in focus due to the depth of field of the lens but, if near the outer edge of the drawing, would result in displacement of the lines from their correct positions.

In any camera installation, one element should be fixed and the other two adjustable. A satisfactory arrangement is to have the negative holder fixed in one wall of a room with the lens and copy board mounted on a structure extending across the room. Moving the lens and copy board is frequently done by electric motors with the final adjustment being made manually. Positioning indicators, reading to 0.001 in., are desirable for accurate work.

USES OF THE PROJECTION METHOD

1 Exact duplicates, reductions, or enlargements of the engineering drawing are easily made.

2 Parts for an experimental or production airplane can be produced by laminating "matte transfer paper" emulsion directly onto the alclad or dural that is to be used in the fabrication of the part. In this way all cuts, drill holes, rivet holes, lightening holes, forming outlines, and any other information pertinent to the fabrication of the part can be indicated by the photographic image.

3 Drill jigs may be laid out directly in the camera with the location and size of each drilled hole shown. Any necessary weight sheet or plate may be photosensitized and the layout accurately reproduced thereon, the holes "buttoned" and bored, and the bushings inserted. In work which permits large tolerances, the labor needed to produce satisfactory drilling jigs and templates can be greatly reduced.

4 Templates are produced in the same manner as second originals and are used as flat patterns for cutting out sheet parts that are to be formed or used flat.

5 Router blocks may be produced directly by printing on thin metal sheets, which are later fastened to masonite or plywood, and cut to the desired outline. These blocks are then used to guide router tools which form many flat parts simultaneously from a stack of metal sheets.

6 Form blocks are usually made of tempered masonite, the print being made directly on the masonite surface. These blocks are used for forming parts in either a drop hammer or a hydraulic press.

7 Models of irregular punches and dies to be used in deep forming in hydraulic presses or drop hammers may be made rapidly and quite accurately. Contour planes spaced regularly (i.e., 1-in. centers) are established and the contours drawn for each station. These contours are then photographically printed on thin sheet metal and, after processing, the template for each contour station is cut to the line. These templates are assembled on a base in which parallel slots are cut, spaced the same as the original contour planes. Plaster of Paris is poured into this mold and wiped off to conform with the contours. The mold thus formed is used to cast permanent metal blocks.

8 Reduced-scale models for wind-tunnel experiments are easily made on the camera by changing the degree of enlargement to conform with the model size required. By this process, extreme accuracy of scale can be obtained in models as small as $^1/_{64}$ of the original.

9 In order to save considerably in the cost of blueprint or diazo materials and to facilitate handling prints in the shop, it is common practice for the aircraft plants to make their phototracings from engineering drawings at one-half scale. On one job recently surveyed, which involved the reproduction of thirty thousand drawings, there was a saving of nearly a million square feet of blueprint materials, which represented an actual cost of approximately ten thousand dollars.

CONTACT METHODS

In the contact methods of image formation, the original drawing is placed in contact with the photosensitized sheet and exposure made either by ordinary light or by X rays. This method avoids any possible change in dimensions from original to copy. Change of scale is not possible.

The original drawing may be made on a transparent material like glass or Vinylite and printed on the photosensitized sheet by transmitted visible light. Transparent drawing-board materials must be selected with care because few transparent sheet materials have sufficient dimensional stability to serve satisfactorily for accurate work. Vinylite covered with an opaque lacquer has been used. In this case, the drawing is made by scribing through the lacquer, and either true or mirror-image reproductions can be made, depending upon whether the sheet is placed face up or face down on the sensitized material.

Glass drawing boards are made by spraying the surface with a lacquer which is commercially available. This lacquer is transparent, unpigmented, and made from a nitrocellulose base. The surface can be sanded and pumiced to obtain the desired pencil tooth. When the drawing is finished, it is placed in contact with the material, then exposed and processed. This produces a mirror image of the original drawing. If a true image is necessary, an intermediate negative is made on a

THE LAMINATING PROCESS

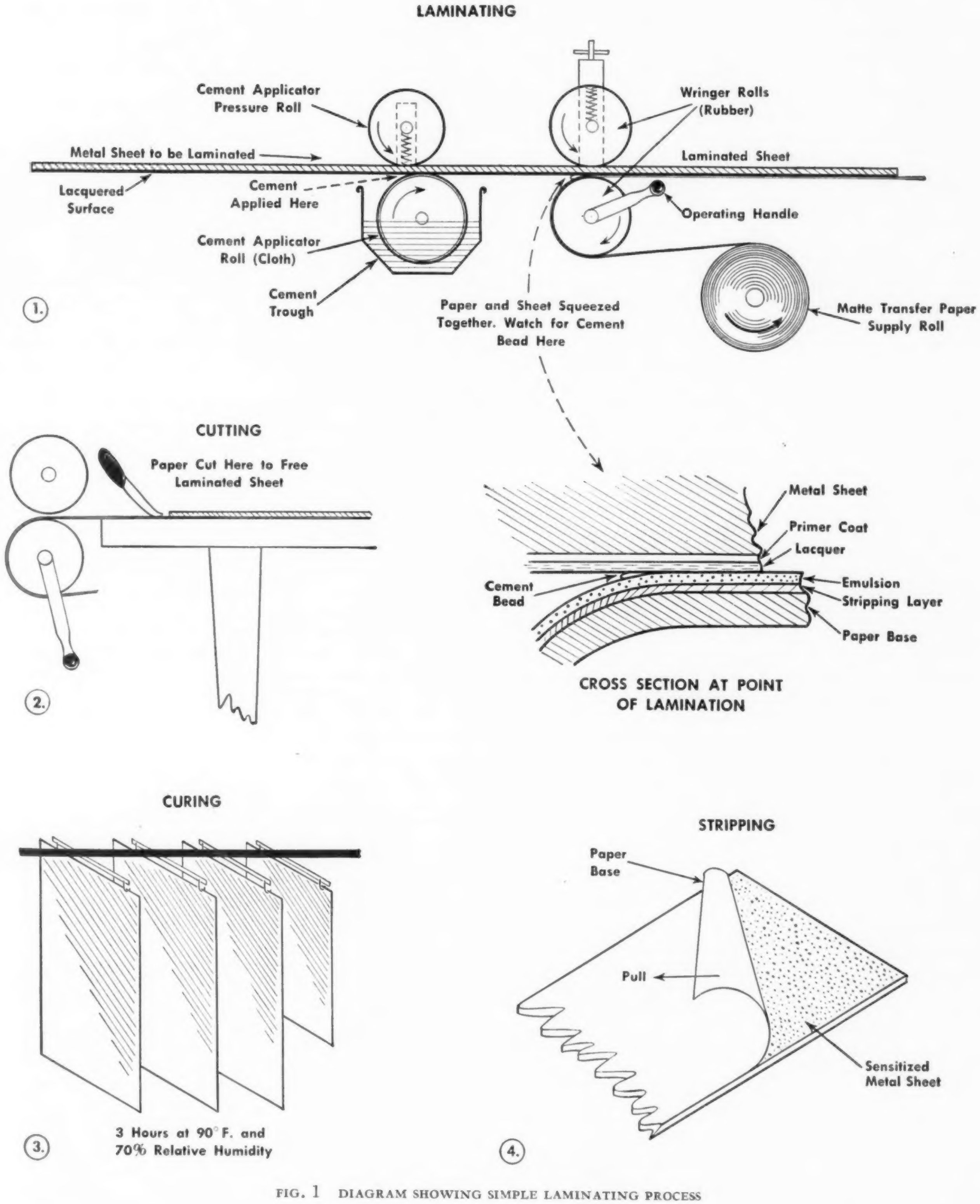


FIG. 1 DIAGRAM SHOWING SIMPLE LAMINATING PROCESS

photographic plate. This can then be printed on the sensitized metal sheet to form the template. It is impractical to make a contact print yielding a true image directly from a glass drawing board, since the drawing board would have to be placed face up on the sensitized material and the scattering of the light going through the glass would widen and blur the lines.

A recent development utilizes a metal sheet coated with a lacquer which phosphoresces after illumination by ultraviolet radiation or visible light. This specially pigmented sheet is placed under the transparent material to be duplicated and the image transferred by irradiation with ultraviolet light. The negative thus obtained glows brightly and is placed in contact with the sheet material which has been sensitized. In this way, a true image positive is obtained. These processes utilizing glass or Vinylite have the benefit of simplicity; practically the only equipment required being a vacuum printing frame to insure perfect contact during the printing process. They have distinct disadvantages, however, since Vinylite sheets are easily scratched, have relatively high thermal expansion, are available in limited sizes, and glass plates are easily broken and are difficult to handle and store, particularly in larger sizes.

A more satisfactory method of contact printing utilizes industrial X-ray equipment. Certain substances emit light when irradiated by ultraviolet or X rays. When this light emission continues after the source of excitation has been removed, it is known as phosphorescence. Calcium tungstate, zinc sulphide, etc. are materials sensitive to X rays. When irradiated, they emit a bluish-violet glow which, in some cases, continues for many minutes after the X ray has been stopped. The light emitted is suitable to expose blue sensitive photographic emulsions. When using this process, the original drawing is made on a sheet which has been sprayed with X-ray phosphorescent lacquer. This lacquer may be surfaced as in the case of the glass drawing board to give any desired tooth for the drawing pencil. Drawings may be made with a pencil, india ink, silver solder, or gold wire. When the drawing is completed, it is exposed to X rays for a sufficient time to establish the phosphorescence. A typical exposure for a 5-ft × 10-ft plate might be 5 min, at a distance of 14 ft from the X ray with 220 kv and 20 ma.

The drawing is then ready to be printed and is placed in contact with the photosensitized metal or other material in the vacuum printing frame. Exposure is made and the sheet processed to produce a negative. The time of exposure is sufficiently short so that a number of copies can be obtained from a single irradiation of the original drawing.

A more useful variant from this method utilizes a material which has been coated with phosphorescent lacquer before being photosensitized. This material is exposed to the phosphorescing original drawing in a vacuum printing frame and is then processed to produce a negative. This negative can, in turn, be irradiated and printed by contact on a photosensitized sheet which, when processed, produces a positive.

A variation which has been used consists of coating colored opaque lacquer on top of the luminescent lacquer. Gray-green has been found to be a suitable color for the draftsman who makes his drawing by cutting through the colored lacquer so that the luminescent material is exposed but not scratched off. Such a drawing, when irradiated and printed, gives a mirror image consisting of black lines on a white ground.

USES OF THE X-RAY CONTACT METHOD

While the contact method is more limited in scope than the projection method, it is desirable in many cases from the standpoint of accuracy, production, and cost. Several general applications may be mentioned, as follows:

1 To make original-sized mirror-image templates. If they are to be used only as flat patterns for the cutting out of the sheet parts, this matters little, since the template can be turned over. However, if detail is required on the surface, then an intermediate transfer board must be prepared.

2 To make drill jigs from photographic copy, as in the projection method.

3 To make die-model profiles as with the camera method.

4 To make router blocks.

5 To make form blocks from pieces of sensitized masonite.

6 To make full-scale phototracings from original drawings on metal plates for use as blueprints, etc.

7 To make full-scale vellums.

8 To do any job where change of scale is unnecessary.

PREPARATION OF PHOTOSENSITIZED MATERIAL

The range of materials which can be photosensitized by lamination with matte transfer paper is very wide. Nearly all sheet metals, plywood, or masonite can be readily utilized. Two precautions should be observed, i.e., the sheet materials must be carefully cleaned, and any material which would affect the photographic emulsion or processing solutions must be isolated by means of suitable protective coatings.

The simple laminating process is shown in the line diagram, Fig. 1. The direction of travel of the material is from left to right. In this diagram only one stock roll is indicated, but, when very wide sensitized sheets are required, two stock rolls are necessary, since the maximum width of matte transfer paper is 40 in. Such an arrangement is shown in Fig. 2. The parts of the laminator, as indicated by letters in the illustration, are listed with the illustration.

In the laminating room, double overhead fixtures, fitted with Wratten Series O-1 "safelights" should be used. It is advisable to remove the laminated sheet immediately to the curing room and to keep the curing room safelights turned off except during the actual operation of transferring the plates. The laminating process is simple, and the laminator may be built by any good machine shop. It is important that the rubber-covered rolls be truly cylindrical and of equal diameter throughout their length. They should be carefully aligned with each other and with the stock roll to avoid causing side travel of the paper with subsequent wrinkling and variation of the space between the sheets when two stock rolls have to be used. The amount of cement is also critical, either too-large or too-small amounts being unsatisfactory.

PHOTOCOPYING COSTS

The cost of equipment for both the contact and the projection methods will vary with the volume of work done and with the maximum size of sheet provided for. The following estimates give comparative costs of equipment and installation of the necessary photographic units for the two principal methods:

Projection Method

1 Camera installed	$16000
1 Laminating machine (including freight and installation)	1800
4 Processing tanks	900
Total	$18700

Luminescence Method

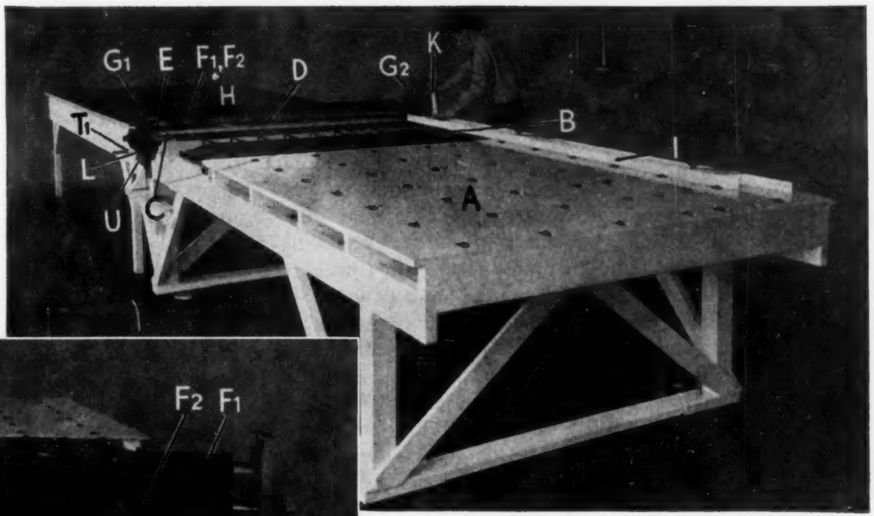
1 X-ray phosphorescence unit (including cabinet)	$ 5500
1 Vacuum printing frame	1000
1 Laminating machine	1800
4 Processing tanks	900
Total	$ 9200

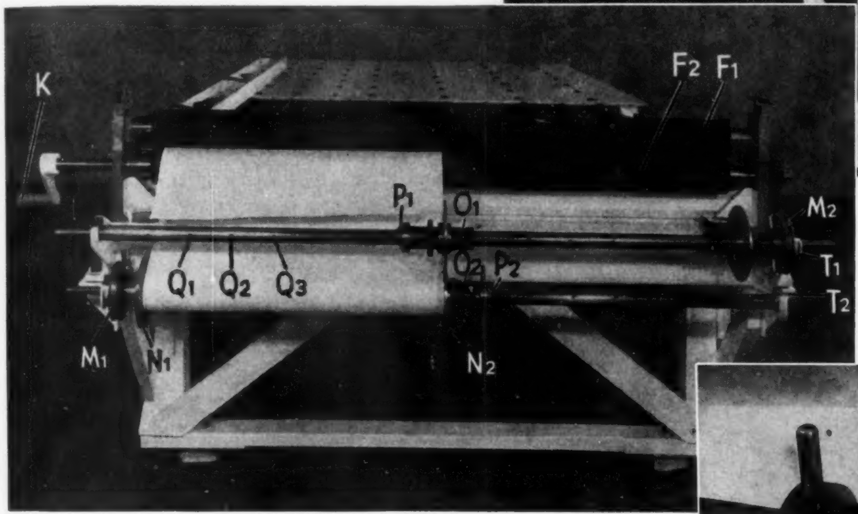
CONCLUSION

A vice-president in charge of manufacturing in one of the larger airplane companies recently made this statement:

"Every time that a new airplane model is placed in production

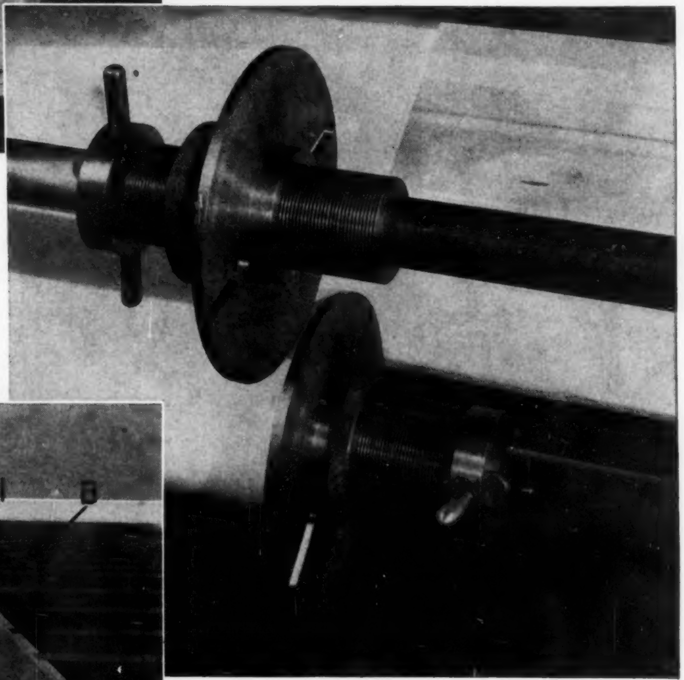
A. . . . . .Feed table
B. . . . . .Conveyer table
C. . . . . .Cement-applicator roll
D. . . . . .Cement-applicator pressure roll
E. . . . . .Cement pan

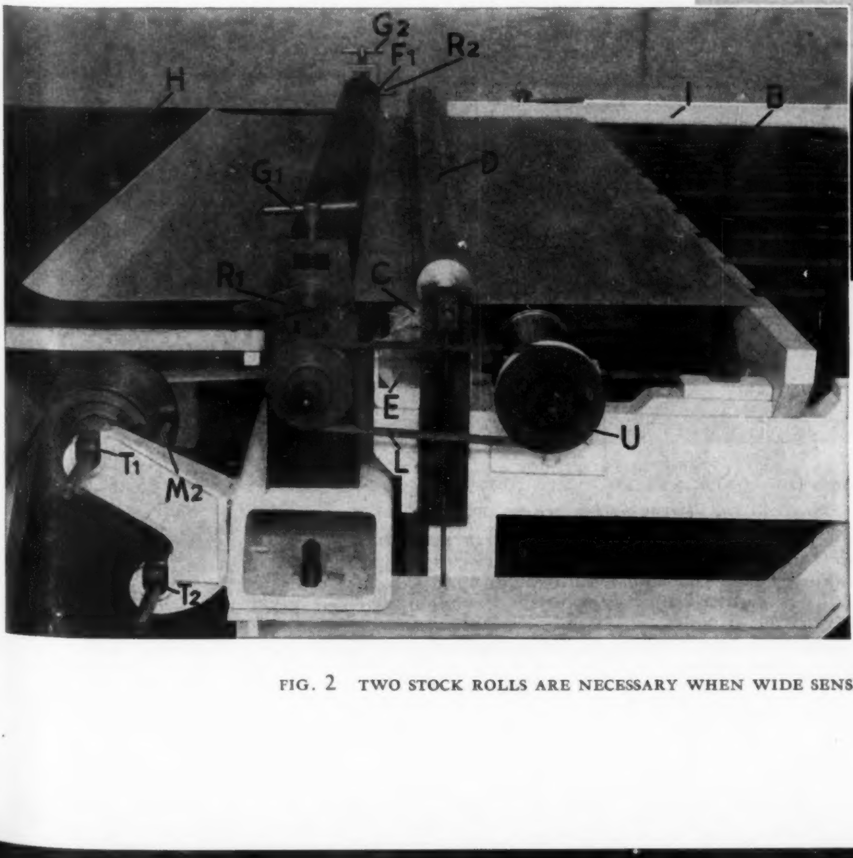




L. . . . . .Drive belt
U. . . . . .Conveyer-table pulley
T_1, T_2. . . . . .Sleeve bearings
M_1, M_2. . . . . .Stock-shaft friction brakes

F_1, F_2. . . . . .Wringer rolls
G_1, G_2. . . . . .Pressure screws
H. . . . . .Receiving table
I. . . . . .Stock guide bar
K. . . . . .Crank shaft





N_1, N_2. . . . . .Stock-shaft flanges
O_1, O_2. . . . . .Stock-shaft sleeves
P_1, P_2. . . . . .Stock-shaft locking pins
Q_1, Q_2. . . . . .Stock-shaft holes
R_1, R_2. . . . . .Release levers

FIG. 2 TWO STOCK ROLLS ARE NECESSARY WHEN WIDE SENSITIZED SHEETS ARE USED

it is necessary to provide upward of twenty-five thousand templates of sheet metal to control routing, drilling, punching, inspecting, and other operations. As many as fifty different types of templates may be required for one panel alone, and generally from five to eight templates of each type must be made. Within the last year or so a number of airplane companies have adopted a photographic method of reproducing templates from accurately made drawings. By this method, templates that may formerly have required several weeks to lay out are now being reproduced in a matter of minutes. With the photographic method of template reproduction, the time between the completion of engineering drawings for a new plane and the test flight of that plane has been reduced two to four months. Another outstanding advantage is the reduction in template cost."

Here in brief are the principal advantages of photocopying: (1) Considerable time saving by the elimination of manual drafting and checking, and (2) the consequent economy. In addition, a number of other developments are made possible by modifications in the photocopying processes. In particular, we may list the following:

(*a*) Rapid reproduction of drawings and templates. This is of great importance for subassemblies and subcontracting.

(*b*) Modifications of models can be made readily on copies photocopied from the old detail drawings.

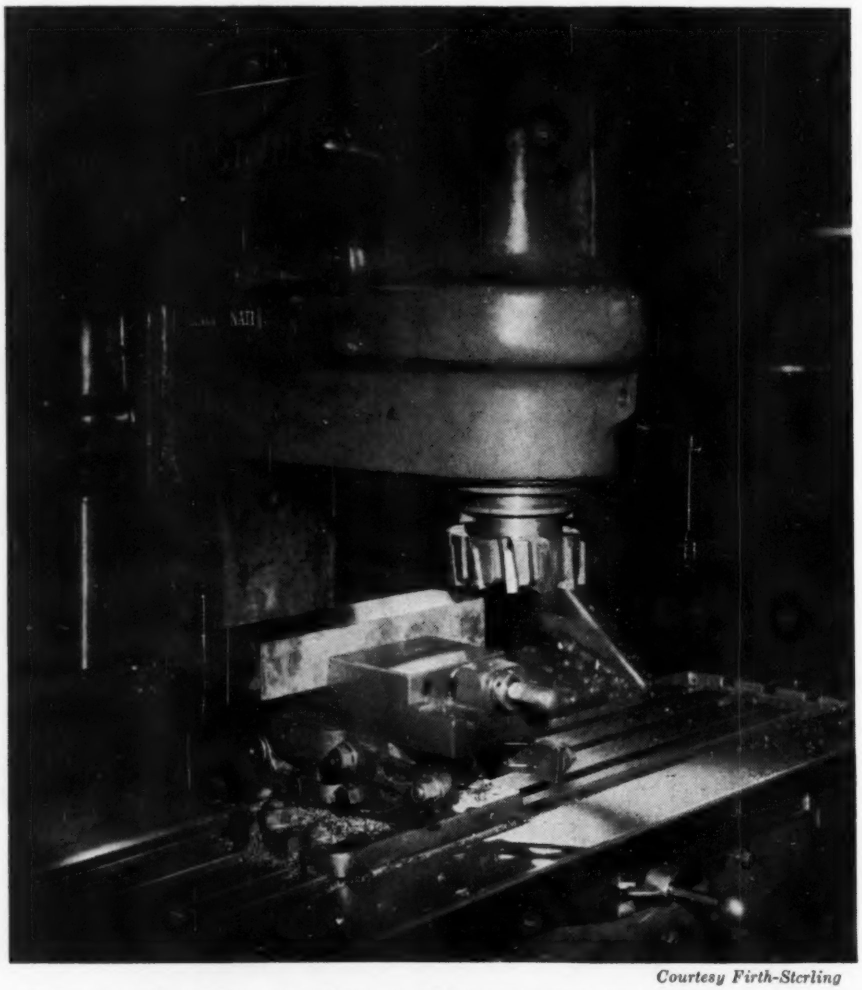
(*c*) Small-scale models for any purpose can be rapidly obtained by reduction in the camera from the full-scale drawing.

(*d*) Shrink templates for casting patterns and plaster mock-ups can be rapidly made by increasing the enlargement in the camera.

(*e*) Small-scale, accurate engineering layouts can be photographed and enlarged to full scale.

(*f*) All copying errors are eliminated and there is no necessity for rechecking. Dimensions may also be omitted from the template drawings so that possibility of error in the transcription or calculation is removed. It should be emphasized, however, that drawing errors are never corrected by photocopying.

With these advantages in mind, photocopying is seen to be essential wherever mass production of many units is made from a single model.



Courtesy Firth-Sterling

HYPER-MILLING CUTTER IN ACTION ON ANNEALED ALLOY TOOL STEEL AT 419 RPM, WITH 1/16 IN. DEPTH OF CUT AND FEED OF 5 3/4 IN. PER MINUTE

(The hyper-milling process uses sintered carbide tipped inserted blades with both the rake and helix angles of the mills negative up to 10 degrees, with the cutters operating at speeds up to 10 times those normally used, and with resulting feeds up to six times those of conventional high speed mills on hardened alloy steel parts. Hyper milling results in burnishing the surface of the work being milled, produces less tool wear, and keeps both the work and the tool cooler, resulting in a minimum of distortion, even on fragile work pieces.)

Use of MIXTURES *of* OIL *and* COAL *in* BOILER FURNACES[1]

By W. C. SCHROEDER

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THE shortage of fuel oil on the eastern seaboard has revived interest in the mixing of oil with coal to produce a fuel suitable for use in oil-burning industrial furnaces without material alteration in equipment. The preparation of stable oil-coal mixtures was intensively studied in 1917 and 1918, in connection with the work of the Submarine Defense Association,[2] but there has been relatively little interest since that time, probably because of the low cost of fuel oil in this country. In Great Britain, on the other hand, while interest has been spasmodic, it has never disappeared entirely.

In marine use, oil-coal mixtures have two fundamental advantages over oil alone: (1) Coal is more universally distributed, and shipping difficulties, for at least part of the fuel, may be decreased. (2) The heat content per unit of volume is about 1 to 4 per cent greater, which allows some saving in bunker space. During a war, however, any increase in the ash content of a fuel used for marine purposes is undesirable since it produces a trail or slick on the surface of the water. The higher the ash content, the longer the trail is visible and the more easily it may be followed by enemy vessels.

Stationary plants frequently have their boilers equipped to burn either pulverized coal or oil. During the present oil shortage, they will obviously be rendering a national service by using coal alone, irrespective of the economic or convenience factors involved. Many plants equipped to burn oil might install pulverized fuel or stokers, but steel and equipment shortages make these changes troublesome if not impossible. At the same time, limited combustion space and passage for the gases, combined with the absence of provision for ash disposal would make the use of solid fuel difficult and greatly reduce boiler output. The development of oil-coal mixtures which could be used in ordinary oil-burning equipment would offer a solution to some of these problems, particularly if the composite fuel were prepared and distributed to the individual plants from centrally located points much as fuel oil is handled at the present time.

In this report, the use of oil-coal mixtures is considered only for furnaces under stationary boilers. The field of application may be expanded if this work is successful.

Most investigators have attempted to stabilize the oil-coal mixtures with metal soaps or with fatty acids. From preliminary studies, it appears that coal tar may be better than the soaps. Fine grinding of the solid fuel simplifies the problem of stabilization, but it tends to increase the viscosity of the final mixture. Irrespective of how the fuel is made, careful consideration must be given to the effect of coal ash in the combustion space.

[1] Published by permission of the Director, Bureau of Mines.

[2] A group formed in 1917 by American shipping, insurance, and oil companies under the chairmanship of Lindon W. Bates.

Presented at the Sixth Annual Meeting of the Fuels Division, of The American Society of Mechanical Engineers, and the Coal Division of the American Institute of Mining and Metallurgical Engineers, St. Louis, Mo., Sept. 30–Oct. 1, 1942.

STABILIZATION WITH SOAPS

The earliest work using soaps for stabilization was carried out in connection with the investigation of the Submarine Defense Association.[2] In the decade following this study, a few patents were issued in this country relating to the use of soaps or saponified products for stabilization. In Great Britain a number of patents were taken out and plans were made for extensive commercial development under L. W. Bates. In that country numerous tests were also made with oil-coal mixtures in furnaces under marine boilers and more recently the Fuel Research Board has reported laboratory studies directed toward the stabilization of suspensions.

Investigation by Submarine Defense Association. During 1917 and 1918, the Submarine Defense Association after laboratory investigation prepared about 80 bbl of fuel for tests on the *Gem*, a private seagoing yacht which had been taken over by the Navy and which was operated chiefly in Long Island Sound. The suspension was made by mixing finely ground Pocahontas coal with a Texas oil.

The suspension was stabilized with a rosin-lime grease called a "fixateur." This was made as follows: About 15 per cent rosin was melted in fuel oil to give a mixture of about the consistency of butter. A low-magnesium finely powdered lime was then slacked without overheating and immediately mixed into the heated rosin-oil mixture with good agitation. The amount of lime added was about equivalent to the titratable acid of the rosin.[3]

In the preparation of the fuel the fixateur (about 0.5 to 4 or 5 per cent) was added to the oil which had been slightly warmed and then the coal was run in to make up about 30 to 40 per cent by weight of the composite fuel, the whole being thoroughly mixed, strained, and barreled. Table 1 summarizes the important data regarding the fuel which was prepared for the *Gem*.

During the first tests, using pressure-type burners, clogging and difficulty were encountered. This was corrected by attaching a steam purge which was used intermittently to clean the burners.

[3] Sheppard reported experiments in 1924 (S. E. Sheppard and L. W. Eberlin, *Industrial and Engineering Chemistry*, vol. 16, 1924, p. 832) concerning the use of the rosin-lime grease for stabilizing asphalt and free carbon in the tar from the pressure-still distillation of petroleum. His results are as follows:

Per cent rosin (total oil)	Gasoline precipitable pitch;[a] per cent retained, 5 weeks' sedimentation	Per cent sludge, 5 weeks' sedimentation
0.0	3.35	0.43
0.25	3.36	0.42
0.50	3.78	0.00
1.00	3.78	0.00

[a] Original pitch, 3.78 per cent.

He also found that the viscosity of the tar could be considerably reduced by the addition of 5 per cent naphthalene without causing precipitation of asphalt and free carbon.

TABLE 1 FUEL USED ON THE GEM

	Coal, Pocahontas	Oil, Texas	Mixture
Proportions, per cent	31	68	Lime-rosin fixateur, 1
Btu per lb	14000	18700	17100
Specific gravity at 25 C	1.39	0.92	1.03
Size	99.7% through 100 98% through 200 85% through 300	....	.....
Viscosity, deg Engler	....	18.1 at 20 C 9.3 at 30 C	170 at 70 F

A lime-rosin fixateur was also used to stabilize a mixture of coal in oil by the Standard Oil Company in one of its plants in Brooklyn, New York. It is reported[4] that this company had a large amount of high-ash anthracite which it was desirable to use by burning under its boilers. About 40 per cent of the anthracite was mixed with an oil containing 40 per cent pressure-still oil. In order to raise the viscosity of the pressure-still oil, it was mixed with about 15 per cent No. 1 road oil. The fixateur was used in amounts equivalent to $1^1/_2$ or 2 per cent of the oil.

During 1920 and 1921 the company succeeded in utilizing its anthracite coal by this means, but it is doubtful if any great emphasis were placed on securing a stable suspension. Instead, the primary object was to find a means for burning coal that otherwise might have been wasted.

Sheppard has recently called attention to the possible substitution of metal soaps from naphthenic acid for rosin soaps.[5] Typical naphthenic acid and possibly metal naphthenates have been reviewed by Littman and Klotz.[6] The effectiveness of these materials, in maintaining the suspensions of coal in oil, has not yet been determined.

United States Patents and Investigation on Stabilization With Saponified Products. The earliest patent taken out in this country concerning mixtures of oil and coal was issued to Smith and Munsell, which was followed by one 25 years later to Spelman.[7] Neither of these patents created any widespread interest in mixed fuels. Two patents were taken out by Greenstreet.[8,9] Both were concerned with methods for increasing the viscosity of the oil so it would hold the coal in suspension. This was accomplished by several means including air oxidation of the oil. The second patent[9] covered emulsification of the oil to thicken it and prevent settling of the coal. Soap, and water and soap are mentioned as suitable emulsion stabilizers. In 1927, Greenstreet[10] secured a third patent, relating to the suspension of a pulverized and purified solid fuel in a liquid fuel. The essential means suggested for purifying the solid fuel was the removal of ash by treatment with oil and water which rejected the ash to the water fraction. Stabilization of the suspension was accomplished by emulsification or thickening of the liquid fuel in which the purified coal was suspended.

A patent based on German investigation was taken out in 1928,[11] concerned with the suspension of brown coal or lignite in an alcohol solution containing caustic. This process was apparently of greater importance in connection with the hydrogenation of coal than in the preparation of a fuel for combustion.

Arthur W. Burwell secured a patent in 1928[12] for a process for suspending a finely divided solid fuel in a gel made from liquid petroleum. Metal salts of a saponifiable acid are indicated as suitable stabilizers.

One of the recent patents, relating to the preparation of an oil-coal mixture, was granted to Kern[13] in 1933. Coal of 200 mesh or finer was mixed with water in a pugmill, and the plastic mass was rapidly heated in a retort to 550 C. The patent indicates that pressure from the water vapor in the coal would blow it into a highly porous voluminous mass. The cooled product is then ground to about 200 mesh, and the carbon powder, which is reported to have a specific gravity from 0.3 to 0.5, is mixed into fuel oil.

The patent states: "The lightness of particle and fineness of particle size, together with the residual volatiles in the powder, coact to effect a substantially permanent suspension of the carbon powder in the oil." The writer has not found any industrial application of this process but work at the Armour Research Foundation indicates that a sudden release of steam pressure can cause coal to expand permanently into a highly porous structure.[14] This supports Kern's contention that the coal can be blown into a highly porous voluminous mass.

The processes developed through the work of Greenstreet[15] apparently formed the basis for the commercial development of a composite fuel marketed under the name "Coalinoil." In burning tests for relatively short periods under two small Scotch marine boilers, it performed satisfactorily. It is reported, however, that difficulty was encountered in storing the fuel, because the suspension was not entirely stable.

In most instances, bituminous coal has been used in the preparation of the composite fuel. However, one attempt to use anthracite has already been noted.[4] Anthracite culm or waste might offer a possible economic source of solid fuel, and investigation of oil-anthracite mixtures may be desirable. On the other hand, it should be recognized that anthracite has several characteristics which make it less desirable than bituminous coal. It is high in ash, difficult to grind, and ignites slowly. Furthermore, stabilization of an anthracite-oil mixture may be more difficult than an oil-bituminous coal mixture. The bituminous coal contains organic matter which tends to dissolve or be wet by the oil or stabilizing agent, while the anthracite is relatively pure carbon. At the present time, it would appear that bituminous coal would generally be preferable for a composite fuel.

Investigation by Bates in Great Britain. L. W. Bates, an American engineer, was closely associated with the work of the Submarine Defense Association.[2] He went to Great Britain after the war of 1914–1918 and continued the study of colloidal fuels or oil-coal mixtures, as evidenced by the series of patents taken out in his name[16] during 1921 and 1922. These deal with resin, soap, rubber, tar, and petroleum-pitch stabilizers, methods of grinding and mixing, and removal of ash.

[4] Information supplied by S. E. Sheppard, Eastman Kodak Company, Rochester, N. Y.

[5] Private correspondence.

[6] "Naphthenic Acids—II, Manufacture, Properties and Uses," by E. R. Littman and J. R. M. Klotz, Jr., *Chemical Reviews*, vol. 30, Feb., 1942, pp. 97–111.

[7] U. S. 219,181 (1879), H. R. Smith and H. M. Munsell; U. S. 766,365 (1904), M. R. Spelman.

[8] U. S. 1,432,178 (1922), Charles J. Greenstreet, "Artificial Fuel and Method of Making Same."

[9] U. S. 1,431,225 (1922), Charles J. Greenstreet, "Fuel Product and Method of Making Same."

[10] U. S. 1,623,241 (1927), Charles J. Greenstreet, "Fuel and Method of Producing Same." (Assigned to American Coalinoil Corporation of New York.)

[11] U. S. 1,681,335 (1928), Robert Greissbach and Julius Eisele, "Stable Suspension and Paste of Coal."

[12] U. S. 1,684,125 (1928), Arthur W. Burwell, "Atomizable Mobile Fuel Product."

[13] U. S. 1,899,811 (1933), Ludwig Kern, "Fuel and the Manufacture Thereof."

[14] "Coal Pulverized by Steam Guns," MECHANICAL ENGINEERING, vol. 64, June, 1942, pp. 483–484.

[15] See references 8, 9, and 10.

[16] British Patents Nos. 149,306; 153,591; 154,538; 154,605, 155,209; 159,173; 160,754; 161,929; 165,418; 165,419; 165,420; 165,421; 165,422; 165,423; 165,425.

As a result of Bates' work the Mineral Separation, Ltd., built a plant at Stone Court, near Greenbythe, Kent, England, for the preparation of a colloidal fuel. This was quite a large establishment which incorporated coal-preparation and grinding equipment as well as equipment for mixing the coal and oil. The association between Bates and Minerals Separation, Ltd., was dissolved and little now seems to be known in this country as to what happened to the plant.

Tests on Cunard Liners. There is little published information concerning work on colloidal fuel (oil-coal mixtures) in Great Britain between 1923 and 1932. In 1933 at the annual meeting of the Cunard Steamship Company,[17] Bates reported tests on using oil and coal on the liner *Scythia*. Unfortunately, however, description of this work is meager, and there is confusion as to how successful the tests really were.

The *Scythia* was apparently equipped with six Scotch marine boilers, one of which was fired with the colloidal fuel. Approximately 150 tons of fuel were made for the round trip between Liverpool and New York. It is stated that the coal was ground to pass completely through a 200-mesh I.M.M. screen (about 250 mesh, Tyler), to avoid any danger of choking the jets in the burners. The fuel was handled by the regular equipment used for oil. Manning and Taylor[18] state that with specially designed jets, it might be possible to avoid the very fine grinding of the coal. They also note that no means were available for measuring separately the performance of the boiler on the *Scythia* consuming the colloidal fuel, but there was no indication that it was any different from the boilers using oil.

Manning and Taylor report that the tests on the *Scythia* were quite successful, and that the fuel was stable during the trip and for several months after it was removed from the ship's bunker. However, published information does not reveal the oil and coal used, the fixateur, or the method of mixing. It is believed that finely pulverized coal was mixed with a cracked fuel oil having a carbon-residue content of not less than 5 per cent. The fixateur was probably a lime-rosin grease. It is unfortunate that a more accurate and complete record has not been published concerning these extensive experiments.

The work on the *Scythia* was followed by a test on the *Berengaria*, another Cunard liner. Published information for this test is much less complete than was the case for the *Scythia*, but it is believed that it was not nearly so successful. The coal settled out of the oil, did not burn completely in the furnace, and the ash and unburned coal tended to plug gas passages. It is thought that at times the efficiencies of the boilers dropped as low as 50 per cent. It is believed that the tests on both the *Scythia* and *Berengaria* were based on a process of preparing oil-coal mixtures which was developed by Adam, Holmes, and Perrins.[19] These individuals were apparently of the opinion that the difficulties in the *Berengaria* tests were due to the attempts to use an extremely low-grade high-ash coal in order to prepare a very cheap mixed fuel.

Tests by the Fuel Research Board. Reports from the Fuel Research Board (London) show laboratory investigation of the stability of suspensions of coal in oil during 1933, 1934, and 1935. In 1933,[20] the board reported that 0.1 to 0.5 per cent sodium stearate, dissolved in a heavy refined paraffin oil at 200 C, gave clear gels on cooling which would support indefinitely coal particles about 0.01 in. diam. In spite of this gel structure, the oil could readily be poured from one vessel to another at room temperature.

In 1934,[21] a series of tests was reported on six oil samples, containing 40 per cent coal; the results are given in Table 2. They show that suspensions in straight fuel oils are unsatisfactory. The normally cracked oil gave a more stable suspension than the heavy cracked oil, but the data are too meager to place much weight on this difference. It is also apparent that a high-viscosity oil is not in itself sufficient to insure stability. The oil containing sodium stearate was definitely a gel, even on cursory visual examination, but it did not fall far short of being suitable for oil-coal suspensions because its obvious gelatinous nature disappeared soon after the coal was admixed. The oil with the high petroleum-resin content showed no separation whatever so far as the tests have gone. The resin itself, from this oil, was a solid at 15–20 and a thick liquid at 100 C. (Some resins might exert a considerable solvent effect on the coal. The action may be analogous to that exerted by coal tar as described later in this paper.)

In 1935, the Fuel Research Board investigated and found that no change was produced in the composition either of the coal or the oil by mixing them. The volatile matter, fixed carbon, and ash of the coal remained the same. This same article describes a simple but effective means for measuring the settling of the suspensions: A test tube is mounted in a holder which allows it to swing as a pendulum. The coal-oil mixture is put into the test tube and if settlement takes place the center of gravity of the system falls with alteration in the period of the pendulum. This method of testing is rapid and a large number of suspensions can be examined quickly. The equipment can also be calibrated to give quantitative results.

Investigation by the Submarine Defense Association,[2] the

[17] "Colloidal Fuel," *Colliery Guardian*, vol. 146, 1933, p. 639; also vol. 144, 1932, p. 1179.

[18] "Colloidal Fuel," by A. B. Manning and R. A. A. Taylor, Trans. Institution of Chemical Engineers (British), vol. 14, 1936, pp. 45–59.

[19] See British Patent 396,432 (1932); also later British Patent 409,422.

[20] Annual Report of the Fuel Research Board (London), 1933, pp. 115–116.

[21] Annual Report of the Fuel Research Board (London), 1934, pp. 125–129.

TABLE 2 STABILITY OF OIL-COAL MIXTURES

Oil Description:	A Persian fuel oil	B Mexican fuel oil	C Heavily cracked	D With 0.25% sodium stearate	E Normally cracked	F High petroleum-rosin content
Specific gravity	...	.....	...	0.896	0.925	....
Viscosity:						
Redwood						
at 20 C	212	17240	156	693	790	5500
at 50 C	62	1230	63	130	190	480
Saybolt						
Furol						
20 C	26	2000	21	80	90	630
50 C	...	140	..	19	25	56
Carbon residue, per cent	3.6	9.9	3.8	3.5	3.6	11.0
Hard asphalt, per cent	0.8	2.4	0.4	1.0	2.1	0.7
Stability of mixture						
at 15–20 C	2–3 Weeks		3 Weeks	At least 6 weeks	At least 3 months	Permanent
at 50 C	Not tested			5 Days	At least 6 days	

Koppers Company, and in Japan and Germany, has been concerned with the solubility of coal in coal tar and the influence of the tar in stabilizing a suspension of coal in petroleum oil.

STABILIZATION WITH TAR

Use of Tar in Studies of Submarine Defense Association. From 1918 to 1920, Sheppard, in his work with Bates for the Submarine Defense Association, experimented with mixtures of oil, coal, and coal tar. He found that coals, particularly bituminous coals, could be peptized, that is, partly dissolved, partly suspended, by coal tars, by water-gas tars, and particularly by middle and fraction oils from tar distillation. The effect of temperature on this peptization was examined, and evidence of "saturation" with time was obtained at temperatures around 250 to 300 C. Sheppard has called attention to the fact that extremely fine grinding might increase the amount of tar needed in this method of stabilizing the mixture, because of the increased amount of coal surface. It should also be noted that the relatively high percentages of coal tar, 5 to 20 per cent, were needed and extensive use of a composite fuel of this type would probably create an excessive demand for coal tar.

These oil-coal-and-tar mixtures tended to form a weak gel when they were quiescent, which helped to stabilize them. The gel was thixotropic and was destroyed by agitation so that no difficulty was encountered in pumping or burning the fuel. This investigation was hardly carried far enough to be sure that a stable suspension could be produced, and data were not collected concerning the oils and coals best suited for this treatment or the effect of temperature changes on the suspension. Since this work of the Submarine Defense Association, two patents have been taken out in Great Britain relating to the use of tar stabilizers.[22] During 1942, the Department of Coal Gas and Fuel Industries at Leeds University also reported[23] investigation of the miscibility of coal tars and petroleum oil. Such blends would support pulverized coal in a suspension which appeared permanently stable.

Investigation by the Koppers Company. The Koppers Company investigated processes for dissolving coal in coal tar.[24] While this problem is not exactly analogous to those encountered in making a stable suspension of coal in oil, there are significant points of similarity.

It was found that 35 to 40 per cent bright coal would dissolve rapidly in tar at 300 C (U. S. Patent 1,925,005). By distilling off the tar with steam, the coal could be recovered essentially unchanged from its original form. The coal could also be precipitated from the tar by the addition of 5 to 10 per cent of a petroleum product, such as gasoline or kerosene. It came down as particles of 2 or 3 μ containing $^1/_2$ per cent ash or less. This process might offer a convenient means for preparing a low-ash coal with particles so finely divided that they would not settle rapidly in a heavy oil such as bunker C, even in the absence of a lime-rosin soap or other stabilizing agent. While these possibilities are attractive, there remains the problem of separating the tar and the finely divided coal.

The fact that coal will dissolve in tar helps to explain Sheppard's finding that tar is a good stabilizing agent for oil-coal mixtures. Certain constituents of the coal dissolve in the tar and, in turn, it is probable that the tar partially dissolves in the oil. Since the extent to which these processes take place is influenced by temperature, the stability of oil-coal-tar mixtures might be greatly improved by heating to 200 or 250 C. One of Bates' patents (British No. 154,538; 1922) indicates that heat had a desirable effect on stabilization. More recently Blummer has patented (German, 702,566; 1941) a method for preparing colloidal fuel from coal and a hydrocarbon oil by flowing the suspension through a series of cylinders heated at consecutively higher temperatures up to 450 to 470 C.

The work at the Koppers Company offers one method for converting coal to a liquid fuel. Unfortunately, however, the supply of tar is too small to allow wide-scale application. On the other hand, if a method can be developed for using a portion of the coal-tar mixture as the solvent, then the field of usefulness would be greatly extended. A similar situation would exist if it were found possible to modify coal or oil to make them miscible in each other.

Japanese Investigation of Stabilization With Tar. The Japanese report[25] that attempts to confer dilute gel structures to mixtures of petroleum oil and coal with metallic soaps, Al, Mg-Ca, and Zn soap, were unsuccessful. They have found, however, that a low-temperature tar from selected brown coal (deacidified fraction of 270 to 340 C) is a suitable peptizing agent.

Dry bituminous-coal powder, deashed to about 3.5 per cent, containing 10 per cent of resinous matter and comparatively easy to disintegrate, is peptized with the tar in a combination tube mill at about 100 C. After this pretreatment, the peptized coal particle is dispersed homogeneously in a naphthenic-petroleum heavy oil.

It is claimed that the mixture thus obtained did not deposit coal particles at the bottom of tanks during several months. It is stable for at least 450 days at atmospheric temperature, and at 80 C under a vibratory motion, it remained stable for 350 days. The viscosity was 400 sec by the Redwood viscosimeter at 20 C, and the fuel could readily be pumped through pipe lines at ordinary temperature. At 50 to 80 C, the viscosity was about the same as the fuel oils generally used.

The coal content of the mixture is about 30 per cent; the size of the coal particles ranges mainly from 0.1 to 10 μ or more; the specific gravity, 1.028; the ash content, 1 per cent; and the heating value 17,500 Btu per lb.

With coal particles below 10 μ, it seems reasonable to believe that a stable suspension in a heavy fuel oil could be secured. Whether the high degree of dispersion is primarily due to fine grinding or the peptizing action of the tar is not evident from the report.[25] If the former is the case, the cost of preparing the fuel may be very high. In view of the work at the Koppers Company, concerning the solvent action of tar, this process may have considerable promise and deserves further investigation.

Investigation of Use of Tar in Germany. Manning and Taylor[18] cite tests carried out in Germany in 1932, with a fuel called "Fliesskohle," consisting of a mixture of 55 per cent pulverized coal and 45 per cent tar oil. It was stated that the fuel could be stored, transported, and burned satisfactorily. In tests on a Cornish-type boiler, thermal efficiencies of 70.5 and 74.7 per cent were obtained. It was believed that efficiencies as high as 81 per cent would be possible through continuous operation. These efficiencies are probably based on the low calorific value of the fuel. No information was given about the method of preparation and stabilization. The tar oil used was anthracene oil, having a distillation range of about 270 to 300 C. It is probable that stabilization was achieved by the solvent or peptizing action of the tar alone.

The analyses of the coal used and the final liquid fuel (Fliesskohle) are given in Table 3.

The fineness of the coal was given as through a screen having

[22] British Patent No. 154,538 (1922), L. W. Bates, "Mixtures of Oil, Coal, and Tar;" also, British No. 409,422 (1934), R. A. Adams F. C. V. Holmes, and A. W. Perrins, "Mixture of Tar and Cracked Oil."

[23] *Chemical and Engineering News* (*Industrial and Engineering Chemistry*), news edition, vol. 20, 1942, p. 466.

[24] Major patents covering this work were granted to Harold J. Rose and William H. Hill and assigned to the Koppers Company. See U. S. Patents Nos. 1,925,005; 1,932,535; 1,936,882.

[25] "Coal-Oil Mixtures," by T. Itakura, *Journal, Society of Chemical Industry* of Japan, vol. 40, suppl. binding, 1937, pp. 280B-281B.

TABLE 3 ANALYSIS OF COAL USED AND LIQUID FUEL (FLIESSKOHLE) PREPARED

	Coal, Friedrich Ernestine mine, per cent	Fliesskohle, per cent
Moisture	.....	1.80
Ash	6.39	3.48
Carbon	82.75	84.17
Hydrogen	4.60	5.55
Sulphur	1.03	0.64
Oxygen and nitrogen	5.23	4.36
Volatile matter	22.37	57.42
Calorific value (grams) calories, per g	8010–8060 (Estimated)	8525
Btu per lb	14418–14508	15345

10,000 meshes per sq cm, which is approximately equivalent to passing through 250 mesh, Tyler. The Germans also claim to have produced similar stable fuels using mineral oils instead of coal-tar oils.

COAL GRINDING

Plauson[26] ground mixtures of coal and oil in a colloid mill, driven at high speed, sometimes adding a protective colloid such as soap, gelatin, or rubber. It was claimed that the resulting fuel containing not more than 1 per cent ash would be suitable for use in Diesel engines. The process was too costly for commercial application.

The cost of grinding coal goes up rapidly with the degree of fineness that must be attained. As a rough example, to pulverize coal so that 85 per cent passes 200 mesh might cost about 15 cents a ton. To get 96 or 98 per cent through 200 mesh might easily double the cost. This paper cannot attempt a review of grinding methods and costs, but one company in the United States is engaged in both laboratory and plant tests of fine grinding in the preparation of colloidal fuel, and a few special grinding methods which have been developed deserve consideration.

A number of investigators have considered grinding the oil and coal together[27] to secure a more intimate mixing and possibly a more effective wetting of the coal. There is no clear-cut indication that this procedure increases the stability of the suspension in comparison with grinding the coal and then stirring it into the oil. It will probably have the disadvantage of increasing the cost of grinding. On the other hand, a tube mill or ball mill might be an effective means of mixing coal already pulverized with fuel oil. A systematic investigation, with careful measurement of grinding cost, would be worth while in this phase of the preparation of oil-coal mixtures.

Manning and Taylor cite the experiments of Stephen L. Wyndham, of Wyndham's Liquid Coal Company, Limited, of Cardiff,[13] for preparing colloidal fuel by grinding a mixture of oil with the previously coarsely ground coal in a series of specially designed mills. The most suitable proportions of coal and oil are said to be 1 to 1, and the fuel is reputed to be stable for a minimum period of 4 months at ordinary temperatures. This fuel has been tested in a cross-tube vertical boiler, 6 ft diam and 12 ft high. A specially designed burner of the air-atomizing type was used. With the fuel preheated to about 200 F and fed at a pressure from 15 to 20 psi, and with the air supplied at a pressure of 2 psi, no smoke or grit was observed at the stack. Figures for the performance of the boiler have not been published. The fuel used in the demonstration was made of 50 per cent of washed duff of calorific value 14,360 Btu per lb and 50 per cent of an Anglo-Iranian fuel oil having a calorific value of 19,375 Btu per lb.

Steam pulverization has been successfully applied to the production of very fine powders for a number of industrial uses. This method has not been generally adapted to pulverizing coal, either because it gave a powder considerably finer than was necessary for most uses or because steam consumption and consequently the cost of operation were high. In the preparation of oil-coal mixtures, the suspension can be more easily stabilized if the coal is ground relatively fine and from this standpoint steam pulverizers may deserve consideration.

Lissman[28] has described a pulverizer called a "micronizer" in which the solid material is carried in a gas (steam) stream past a number of orifices through which gas enters at a high velocity; the resulting agitation and impact of particles on each other produces the grinding. He states: "Most applications, having a top size requirement in the range from 20 microns to 2 microns, require an energy consumption in the range from 1 to 10 pounds of steam per pound of product."

Another steam pulverizer that has recently been patented[29] consists of a closed circuit of pipe sections with steam nozzles located at the bottom in such a manner that they create two gas streams rotating in opposite directions. The feed, which must be below 20 or 30 mesh is introduced into these gas streams and pulverization is accomplished apparently by impact of the particles on each other. Steam consumption is reported to be slightly over 1 lb per lb of product with a top size of 30 μ.

For the preparation of a colloidal fuel it would not be necessary to pulverize below 20 or 30 μ. In fact a top size of 60 or 70 μ could be accepted since this is still below 200 mesh. Under these conditions, steam consumption might be cut well below the figures indicated. It should be noted, however, that if superheated steam is used, its temperature must not be so high that the coal becomes plastic or pulverization will be impossible.

Reference has already been made to one attempt at coal pulverization with steam guns.[14] Some work on similar methods of shattering or pulverizing has been carried out at the Bureau of Mines.[30] These methods, however, have not yet reached the stage where they may be considered for large-scale engineering application.

This brief discussion has not attempted a detailed analysis of pulverization but instead has indicated the desirability of fine grinding in the preparation of the oil-coal mixture, as well as some investigations of special methods of grinding. Experimental work in England has shown that bituminous coal ground to 250 mesh (Tyler standard) is stable in certain heavy fuel oils even though a stabilizing agent is not added. In such a case it would be logical to select the most economical process, that is, the cost of the stabilizing agent must be compared with the cost of very fine grinding.

LITERATURE ON STABILIZATION OF OIL-COAL MIXTURES

A number of articles have been published on oil-coal mixtures which deal with specific methods of preparation or use. Only a few have appeared which attempted a broader survey of available information.

One of the most recent is an article by Manning and Taylor,[18] which gives a comprehensive discussion, particularly of investigation in Great Britain. These authors call attention to some tests in 1922, in which composite fuel was used in loco-

[26] ". . . Verfahren zur Darstellung von Kolloiden Dispersionen," by H. Plauson, *Chemiker-Zeitung*, vol. 44, 1920, pp. 553–555 and 565–567. Also see British Patent 17,729 (1913).

[27] L. W. Bates has been granted a patent on one method for doing this; British; 161,929 (1922).

[28] "Jet Pulverizing Now Practical," by M. A. Lissman, *Chemical and Metallurgical Engineering*, vol. 45, no. 5, May, 1938, pp. 238–239.

[29] U. S. Patent No. 2,219,011 (1940), C. H. Kidwell and N. N. K. Stephanoff, "Apparatus for Grinding;" also U. S. Patent No. 2,237,091 (1941), N. N. Stephanoff, "Pulverizing Apparatus."

[30] "Progress in Explosive Shattering of Minerals," by John Gross, U. S. Bureau of Mines, R. I. 3223, Feb., 1934, pp. 19–31.

TABLE 4 COMPOSITION OF FUEL AND RESULTS OF TESTS ON GREAT CENTRAL RAILWAY

Composition of fuel	Elsecar (Yorks) coal dust, 60 per cent; fuel oil, 40 per cent
Method of preparation	Mixed by air-blowing
Moisture, per cent	1.15
Ash, per cent	4.4
Calorific value, Btu per lb	16427
Total fuel consumed, lb	2965
Over-all efficiency, per cent	72

motive boilers. No particular attempt was made at stabilization. The composition of the fuel is shown in Table 4.

These tests were apparently conducted with the idea of using the mixed fuel in India, South America, and the Colonies, where high-grade fuel oil may be difficult to procure.

It is probable that the use of air to mix the coal and oil may have been important in the stabilization of the fuel. Bates has obtained two patents on this process.[31]

Manning and Taylor also present data for oils which form stable and unstable suspensions, as well as the course of the viscosity change with time for each type of oil. They have given an interesting discussion of the economic considerations involved in the use of the composite fuel and indicate that it does not have great possibilities so long as fuel oil is comparatively cheap.

For our present situation in the United States, the shortage of fuel oil on the eastern seaboard tends to remove economic considerations as a major factor, and any method which will extend the supplies will be helpful.

W. H. Martin[32] in discussing Manning and Taylor's article called attention to tests of oil-coal mixtures in an 80-hp Diesel engine, converted into a Rupa coal-dust engine. The fuel used was the German Fliesskohle (made from coal-tar oil and pulverized fuel). It ignited readily at a pressure of 23 atm, which was 5 atm lower than either coal or oil would ignite. It developed a maximum pressure in the cylinder of 47 to 49 atm as compared to 41 to 42 atm for gas oil, and 40 to 42 atm for brown coal. The ignition knock was more pronounced than with oil alone, but the exhaust remained clear.

Martin states: "The colloidal fuel was finely atomized, preheated, gasified, ignited, and partly digested in the Rupa antechamber of this engine, during the compression stroke, which was in communication through orifices with the cylinder, explaining its satisfactory behavior." (The work of the Koppers Company[24] would indicate that this pretreatment would probably cause considerable solution of the coal in the coal-tar oil.)

An article by Hedrick[33] which recently appeared in this country reviews the fundamental factors involved in the preparation and use of a composite fuel. In discussing stabilization with soaps, he points out that trivalent aluminum soaps may be more effective than soaps of bivalent calcium, zinc, lead, and magnesium. Other agents, such as a fatty acid, are more desirable than soaps, particularly since they do not increase the viscosity of the mixture and make it more difficult to pump. Hedrick presents excellent data on the effect of coal concentration on viscosity, effect of temperature on flow of fuels through a 1-in. pipe, and efficiency of methods of grinding.

EFFECT OF COAL ON COMBUSTION

The introduction of coal, with a comparatively high ash content, into a furnace normally burning fuel oil represents a major change in operation. Furnaces are frequently designed to burn pulverized coal, even though the pulverizing equipment is not installed and oil is used. In such instances the introduction of coal with the oil probably would not create serious difficulty. On the other hand, furnaces designed exclusively for oil may have relatively small combustion space, small gas passages, and no means for ash removal from the furnace. Here the mixing of coal with the oil must be done with care, for combustion of the oil may be completed in the furnace while unburned coal particles reach the boiler tubes. The small gas passages may be plugged by coal and ash, particularly if the ash has a low fusion temperature.

In the preparation of the composite fuel, certain steps might be taken to alleviate these difficulties. A bituminous coal should be used which has low ash with a high fusion temperature. Grinding as fine as possible will help to secure rapid combustion. In this connection the use of a tar with the coal which tends to secure some solution of the coal in the oil may be helpful. It may also be necessary to provide some means (probably by hand) for periodically removing ash from the bottom of the furnace. There will unavoidably be an increase in fly ash from the furnace. Finally, operation of the boiler at the same high rating attained with oil may be impossible. The rating that can be secured will depend upon the combustion space in the furnace, the size of the gas passages, the amount of ash in the coal, and the fusion temperature of the ash.

While the magnitude of these difficulties cannot be overlooked if a shortage of fuel forces a change in operation, they are probably not so great as might be encountered in the installation of pulverized fuel or stokers. With pulverized fuel, the ash problem would be greater than with oil and coal, and each industry would face the difficulty and delay in securing the equipment. For stokers, it would be necessary to rebuild the entire furnace to install the stoker as well as to provide coal storage and coal-handling equipment. If the individual plants can be supplied with a colloidal fuel from a distribution center, it is probable that there would be less interruption in operation than in the conversion of each plant to a solid fuel.

CONCLUSIONS

The preparation of oil-coal fuel can be approached from three viewpoints: (1) To make a mixture sufficiently stable so that no settling will occur under any normal condition; (2) to provide stirrers in the storage and transportation equipment which can be run periodically to mix the coal back into the oil; and (3) to mix the oil and coal at the plant where they are to be used and provide agitators or recirculating equipment on the fuel tanks which will prevent settling. This latter procedure would make it necessary to pulverize coal at the plant or to ship pulverized coal to the plant. Since coal in this form may be explosive, it would require careful handling until the mixing with oil was completed.[34] The possibilities inherent in the second and third suggestions should not be overlooked with reference to making a composite fuel available quickly, since they alleviate some of the difficulty in producing a mixture which is stable over a long period.

One of the major difficulties in providing quickly a composite fuel in large amounts is securing the necessary pulverizing equipment. At the present time, this would require 6 months or longer to build. Some equipment might be available from plants where it has been installed as an alternative to oil, but which are so located that they are not in danger of being cut off from their fuel-oil supplies. Another possibility

(*Continued on page 804*)

[31] L. W. Bates, British, 165,421 and 165,422.

[32] "Prime Movers for Indigenous Fuels," by W. H. Martin, *Gas and Oil Power*, vol. 31, 1936, pp. 38–39, 45.

[33] "Colloidal Fuel, The Technical Problems Involved in Its Economic Use," by J. E. Hedrick, MECHANICAL ENGINEERING, vol. 63, 1941, pp. 591–594.

[34] For precautions to be observed see "Explosion Hazards From the Use of Pulverized Coal at Industrial Plants," by L. D. Tracy, Bureau of Mines, Bulletin No. 242, 1925.

Ingenious SOUND ROOM *Tests* *Units on* CONVEYER LINE

By A. L. ATHERTON

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THE solution of some of the more technical problems of mass production during peacetime should increasingly pay dividends as American industry increases its wartime effort. For example, an ingeniously designed testing space open at both ends was developed for testing condensing units for quietness, while they travel on the conveyer line. Despite the open ends, the average sound level in the test area is 37 decibels. A cylindrical sounding board detects any abnormal noise, regardless of the direction in which it leaves the unit. By this technique, condensing units can be tested for quietness, more quickly and accurately.

Test of precision products for freedom from objectionable noise is increasingly difficult as requirements become more critical, and as the inherent sound level of the devices is reduced by progressive improvements in design and manufacture. Sometimes this problem is of major importance in connection with the introduction of improved designs of mechanisms.

FORMER TESTING PRACTICE

Previously, in the production of condensing units, it had been possible to distinguish, by an aural comparison with preselected standards, between normal units and any in which the sound level was higher than standard. This listening test was made in a room through which the units were carried on an overhead conveyer and in which the background sound level was such as could be readily secured when the high level normal to manufacturing space and the requirements for openings through which the units entered and left the room on the conveyer were taken into account. In this test, considerable dependence was placed upon the ability of the operator to distinguish between the sound from the mechanism under test and the surrounding noise, at approximately the same sound level but coming from a different direction and consisting of different pitches or frequencies.

With recent design improvements in units, and with the constantly improving manufacturing control, the intensity of the sounds to be ob-

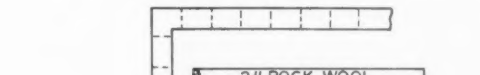

FIG. 2 SECTION THROUGH WALL OF TEST ROOM, SHOWING SOUND-ABSORBING LINER

(The wall treatment consists of three layers of sound-absorbing blankets, graded in thickness and density and mounted on fireproofed wood strips so that the layers hang free and without contact with the wall or the adjacent layer. The floor is covered with ¾-in. Ozite and broadloom carpet.)

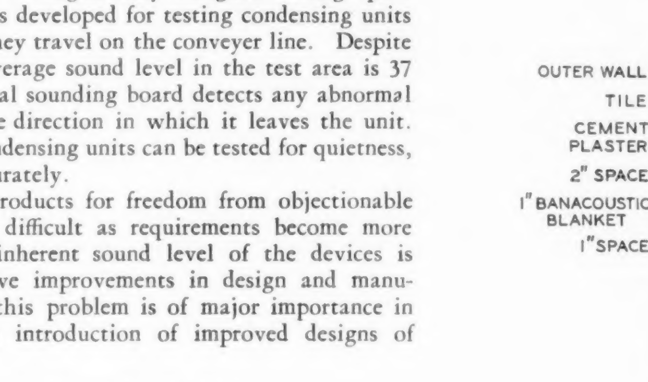

FIG. 1 PLAN VIEW OF TEST ROOM AND TUNNEL ENTRANCE AND EXIT

(Units on conveyer enter from performance test room at *A*, traverse the entrance tunnel, and at entrance to the test room pass the operator's station, where the check is made and recorded. As they pass the operator, they are energized and operated until they leave the operator's station. They then pass out through the exit tunnel to the shipping platform. The operator enters through a vestibule, closed at each end by a Kalamein door with a refrigerator latch, to insure a tight fit against the felt jacket. The vestibule is lined with sound-absorbing material.)

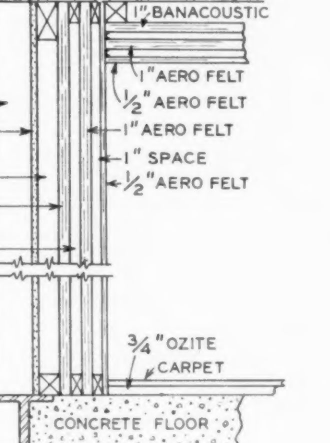

FIG. 3 SECTION THROUGH TUNNEL

(The tunnel walls are of 4-in. terra-cotta tile and are lined with 2-in-thick sound-absorbing material, mounted on fireproofed wood furring strips in order to clear the walls by 2 in. The horizontal partitions are removable for conveyer maintenance.)

served was reduced so much that major improvements were required either in method or conditions of the test.

Although the final outcome will be an instrumental test, it was decided that the transition from an aural to an instrument check could best be made over a considerable period of time by paralleling the two methods for a few tens of thousands of units to make sure that all possible factors are included in the instrumental test before dependence is finally placed on it. This decision involves the definite requirement for a testing space with a sound level 10 or more decibels below that of the units which are under test, in order to insure dependable results.

NEW TECHNIQUE OF TESTING CONDENSING UNITS

The units are tested before mounting in cabinets and are without the noise-muffling effect which the cabinet provides when in actual service. The sound level is so low that it is extremely difficult to get sufficiently quiet surroundings. The problem reduced to the requirement for a space with a sound level of about 30 decibels within the factory where the sound level ranges from 60 to 80 decibels, and with two openings sufficiently large for the units to enter and leave the room. This required a room with two large permanent openings. Actually, the test room had to be much quieter than the average residence, which averages 40 to 45 decibels.

The following design factors solved the problem for such a test space:

1 Springs support the actual test room which is of masonry construction.

2 Free space separates the test room which is enclosed by an outer masonry room, built directly on the factory floor.

3 An effective sound-absorbing medium lines the inner room.

4 Labyrinth tunnels, lined with sound-absorbing materials, are arranged with a number of 180-deg turns between entrance and exit.

5 The conveyer, which traverses the entire length of the tunnels and the test room, is partially segregated from the test space by a sound-absorbing enclosure which is opened only by a slot about 3 in. wide for passage of the hooks on which the units are hung.

The engineering design details of the structure are shown in Figs. 1 to 4.

Fig. 5 shows frequency-analysis curves of the sound level in the space adjacent to the room. It will be noted that the low frequencies are predominant. Fig. 6 is a corresponding curve for the interior of the room and shows that, for all frequencies above approximately 80 cycles, the noise level has been reduced to well below 35 decibels, and for frequencies above perhaps 800 cycles, to approximately 30 decibels.

Actual experience with this new room in operation shows that it meets the requirements of the test with considerable margin to spare. Although the average sound level, as measured by a standard sound-level instrument with 40-decibel weighting, is 37 decibels, this excess over the desired 30 is almost wholly confined to frequencies below 80 cycles and does not interfere with aural tests. As a matter of fact, the threshold of the average ear at 60 cycles is approximately 46 decibels so that the excess over the threshold even at this most unfavorable part of the curve reaches a maximum of only about 9 decibels.

The use of a high degree of sound absorption for the inner walls of the test space resulted in the need for turning the units as they pass the operator in order to make sounds from all angles audible. This requirement was eliminated by the installation of a cylindrical sounding board behind the units opposite the operator. With this arrangement, the operator can detect any abnormal noises, regardless of the direction in which they are emitted from the unit.

The investigations on which the design was based, the design of the acoustic structure, and the test of the resulting structure were carried out by experts of the Commercial Engineering Department of Electrical Research Products, a subsidiary of Western Electric Company.

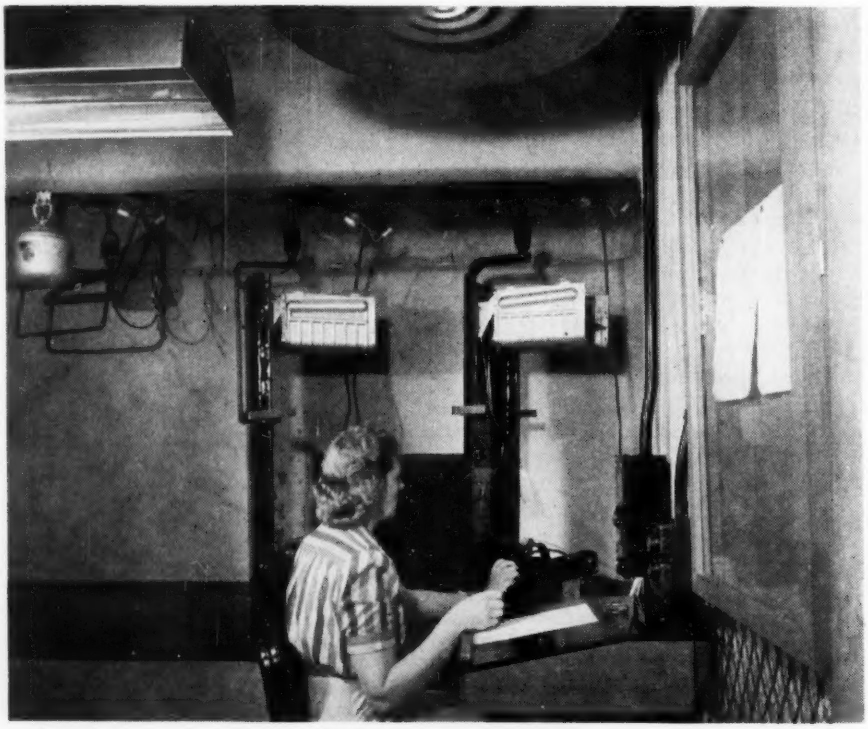

FIG. 4 VIEW OF INTERIOR, LOOKING THROUGH VESTIBULE ENTRANCE

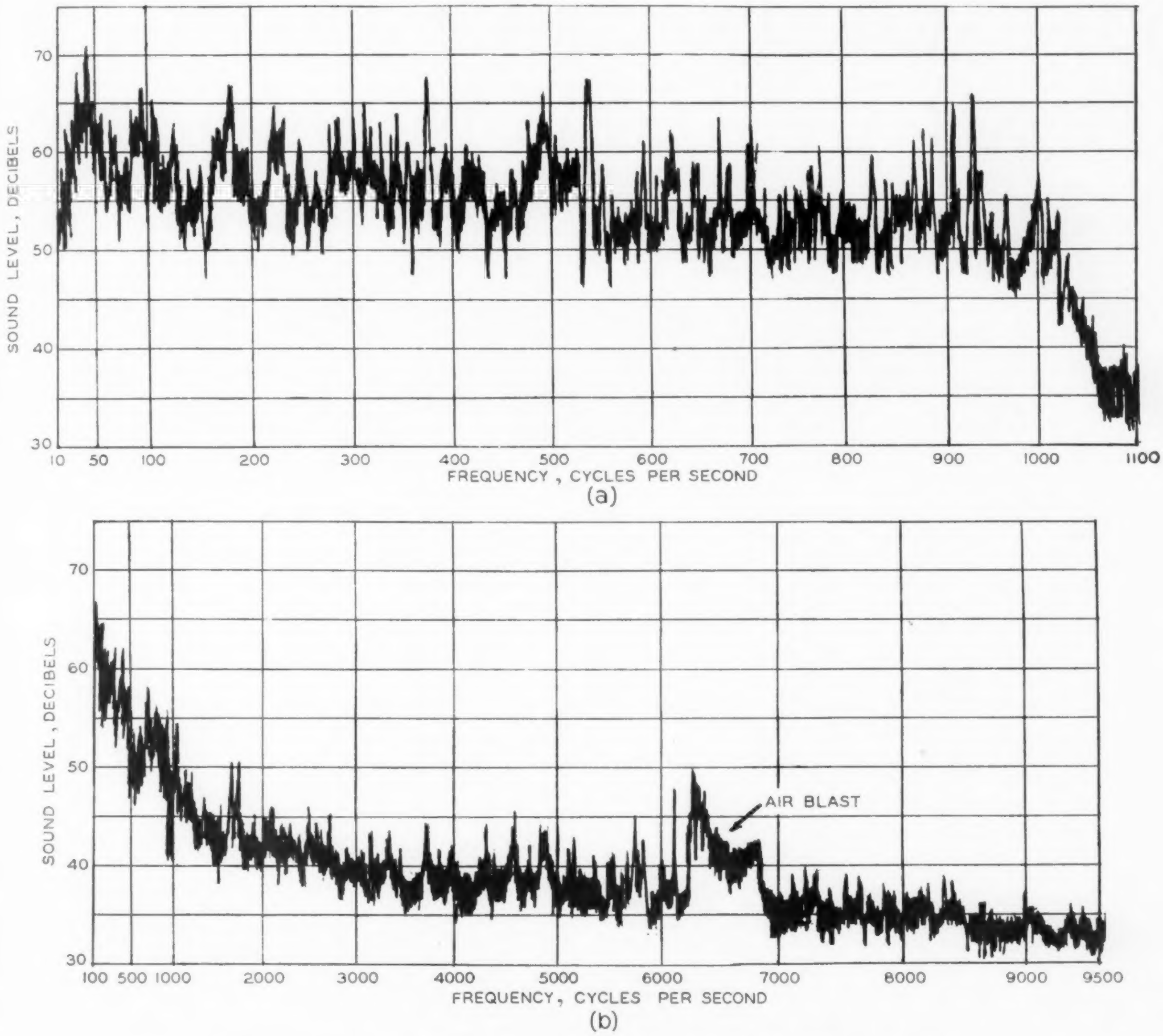

FIG. 5 FREQUENCY ANALYSIS OF GENERAL SOUND LEVEL IN SPACE ADJACENT TO ROOM

(Oscillogram *a* shows a detail up to 1100 cycles, and *b* shows general distribution over complete range from 0 to 9500 cycles.)

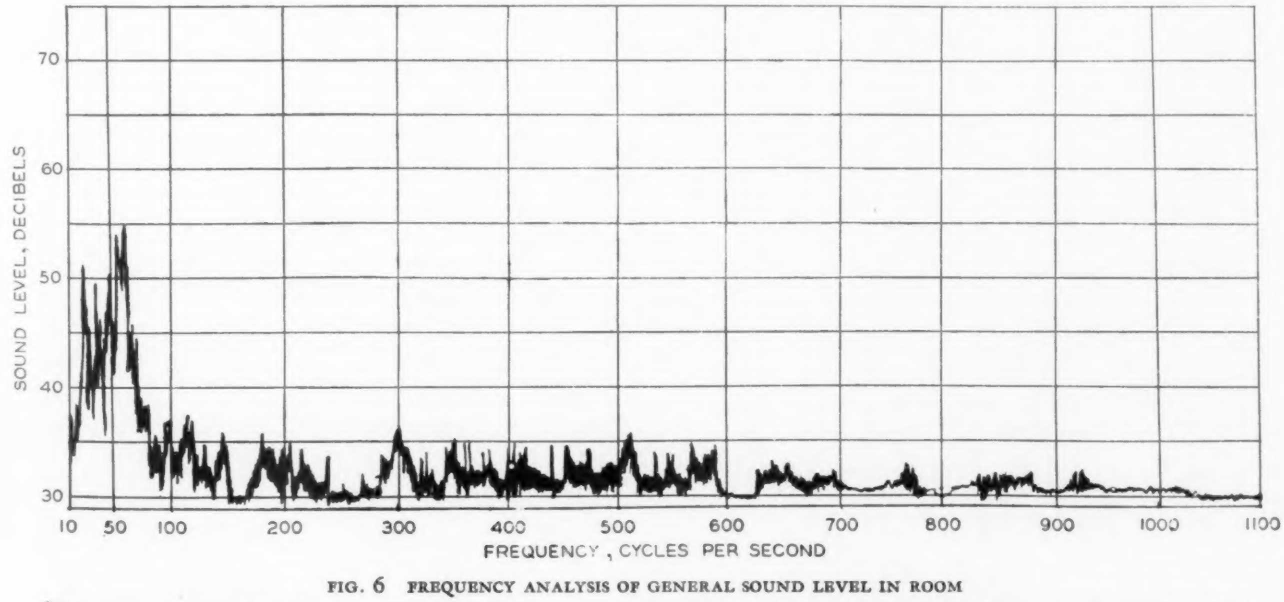

FIG. 6 FREQUENCY ANALYSIS OF GENERAL SOUND LEVEL IN ROOM

(This curve corresponds in range to Fig. 5*a* and shows the almost complete elimination of noise for frequencies above 100 cycles.)

RESEARCH PROGRAM *of the* INSTITUTE *of* GAS TECHNOLOGY

By HAROLD VAGTBORG

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THE Institute of Gas Technology was created just over a year ago to serve its sponsoring industry in a rather unique way. The objectives of the new Institute provide for training of technologists, conducting fundamental and applied research, collecting and disseminating scientific information, and co-ordinating research for the entire industry. Such a program in itself will stimulate research, whether in a company laboratory, or in "farmed out" institutional projects, for the possibility of needless duplication will be eliminated. A tremendous reservoir of research personnel and facilities is available in educational institutions and other agencies throughout the country which can be effectively and efficiently utilized through close co-ordination with the Gas Institute—a centralized agency responsible for research strategy in the industry.

The creation of the Gas Institute does not introduce technology to the gas industry for the first time for, as a matter of fact, a great deal of significant research has been carried on through the years in company and association laboratories and in educational institutions. Its creation does, however, focus attention upon the fact that leaders of the industry recognize that great emphasis must be placed upon technology if the industry is to develop further and to become more fruitful.

The Gas Institute is just beginning its second year of operation. The experiences of the first year indicate that the Institute can operate as both an educational organization and a research institute. The gas industry is somewhat unique, unfortunately, in that it has fewer men trained in its technology than almost any other major industry. For this reason an expanding research program in the industry will bring about the need for trained men. The functions of carrying on research and man training can be done jointly to great advantage. The first objective provides laboratories and workers engaged primarily on research projects on problems basic to the industry. Into this environment are brought young men who have been carefully selected from leading colleges and universities throughout the country. To accomplish the second function a teaching faculty is brought in to train the students in theory, and leaders in the industry, by special lectures, instruct them in actual practice. The over-all program is so operated that each objective is reached effectively and expeditiously without hazarding either cause.

This paper will relate primarily to the research program of the Institute. Anyone interested in the educational aspects may refer to a previous article[1] by Dr. L. R. Thiesmeyer.

The research potentialities in gas are many and revolve about a number of economic factors characteristic of gas. These factors are the foundation of the industry. It must always be remembered that, where heat is required, some 2 to 3 times the amount of useful energy can be made available to a customer in the form of gas from a given amount of coal as can be made available in the form of electricity. The economy of piping natural gas across great areas of our country has been proved. By harnessing the two general forms of gas, the public is assured of a reliable and economical supply of fuel. The use of gas affords better control of atmosphere and temperature; particularly important in industrial heat uses. Gas is a material substance, not merely a difference in potential. Gas can be stored. It has valuable by-products, requires raw materials in its production, and these in turn have valuable by-products. The substances used and produced by the gas industry are potent in industrial and domestic possibilities yet untouched. These are the factors which are encouraging "pooled research" activities in the Gas Institute.

Research contemplated and actually under way at the Institute falls into the following classifications:

1 Fundamental research by students and faculty members.
2 Research on problems basic to the industry.
3 Sponsored research projects.

FUNDAMENTAL RESEARCH BY STUDENTS AND FACULTY MEMBERS

No mention of the Gas Institute's research program would be complete without brief comment on the significance of investigations to be undertaken by its group of highly capable students. Each student has had excellent background in chemistry, physics, and engineering. Only 15 of them are chosen each year from the entire country to pursue master's and doctorate programs at the Institute on special fellowship. Training in research is a vital part of the program and theses are required for both degrees. These must be on fundamental problems and the results publishable in appropriate scientific journals. In the master's program, the student is under close supervision and direction of staff members until he begins to manifest ability to proceed further with merely consultation. The doctorate research, on the other hand, must be a convincing demonstration by the student that he can undertake independent investigation and pursue it to a successful conclusion with only moderate supervision from the staff. The possibilities as to subject matter for student theses are almost limitless. Some may be in the solution of certain collateral aspects of fundamental studies conducted by the staff; some may be an outgrowth of such studies; others may constitute exploratory work of determining important relationships in gas problems unrelated to any upon which the Institute may at that moment happen to be engaged. It should be clearly emphasized, however, that students will not be used in staffing sponsored research projects.

Faculty members will also be engaged on fundamental research projects which relate primarily to the gas industry. However, if a faculty member has a distinct research interest in a field outside of the gas industry, he is permitted to pursue such work. Typical of the research which is being conducted by faculty members is the work on analytical methods of gas analysis. A search of the literature for methods of analysis for

[1] "Gas Institute Training Aids War Effort," by L. R. Thiesmeyer, *Gas*, Aug., 1942, pp. 20–25.

Presented at the Fall Meeting, Rochester, N. Y., Oct. 12–14, 1942, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

organic sulphur compounds in manufactured gas revealed the fact that very little fundamental work has been done on the problem. Most of the data have been obtained on gases of unknown composition and in few cases has a method for an individual constituent been checked for interferences. Thus, although certain methods have been shown to give reproducible results, there is inadequate information as to their absolute accuracy. A research program on this problem was recently begun. The general outline calls for a study of gases of known composition as to (1) methods for determining total sulphur in the gas sample, (2) methods for determining each organic-sulphur constituent, (3) determination of possible interferences. The results of these chemical methods will permit an evaluation of the various possible methods of analysis as to their accuracy, freedom from interferences, and ease of application for routine analysis.

After an acceptable chemical routine for use in the gas company laboratories has been developed, attention will be focused on other general methods of gas analysis. In this respect, attempts at analysis through physical characteristics of the constituent gases will be made. Investigations will be made of such characteristics as (1) vapor-pressure differences as a method of separation, (2) photochemistry of the gases, and the application of physical methods to the study of gas problems. From this research, it is hoped that devices for recording automatically the composition of gas mixtures can be developed. It will also result in a more complete knowledge of the trace constituents of the gas.

RESEARCH ON PROBLEMS BASIC TO THE INDUSTRY

Through this form of research, the Gas Institute is given an excellent opportunity to serve its supporting industry. The costs of this work are met by the general funds of the Institute, and results and data are available solely to member companies. A patentable development becomes the property of the Institute and is available for licensing, and it is expected that this procedure will provide a source of income to broaden and extend further the activities of the Institute.

The gas industry has innumerable basic problems which relate either to production, by-products, storage, transmission, distribution, or utilization. The Gas Institute is setting up projects in these fields just as rapidly as staffing can be effected. In the case of gas production, basic equipment is being prepared to study improved methods of coal gasification. Research in this direction is enthusiastically urged by many gas operators who are convinced that new materials, methods, and scientific tools applied to this old process should produce a more efficient method of gas manufacture having desirable and controllable by-products.

It is obvious that the natural- and manufactured-gas interests, through "pooled research," can more intensively and extensively engage in tracing some of the many unknown scientific facts and reactions of the substances with which they work, and then apply this new knowledge to the development of economical processes which will justify capital investment for better production of acids, acetone, acetylene, alcohol, amines, ammonia, antiknock compounds, benzene, ceresin, chlorination products, ethers, esters, formaldehyde, hydrocarbons, hydrogen, naphthalene, nitration products, reducing agents, and many others. Here lies one answer for plant utilization during low-gas-demand periods. Under such circumstances, gas could become a by-product. Thus, they will tend toward operations which will "take everything but the squeal out of the hog," and by using only the simpler heat components of gas for fuel purposes, the gaseous fuels in general will tend toward uniformity and improved performance in appliances.

Early in its first year of operation, the Gas Institute established a research group to work on catalysis and gas by-products. One objective of this group, and one of immediate interest in the victory effort, is the chemical utilization of gas. One contribution in this direction has been the development of an improved method of producing butadiene from butane, a constituent of natural gas. Other projects are under way to utilize the by-products of manufactured gas as raw materials for plastics, organic chemicals, synthetic rubber, solvents, plastics, and explosives. Studies are to be made of the catalytic reactions of hydrocarbon gases found in or producible from natural gas. Reactions to be studied include oxidation, dehydrogenation, halogenation, hydration, nitration, pyrolysis, polymerization, and alkylation. The products that can be made by these methods will contribute to the victory effort and toward a higher standard of living after the war.

Another objective of this group is to find methods of standardizing the composition of gas so that the manufacture and design of burners can be simplified. Pyrolysis, hydrogenation, and the Fisher-Tropsch process are being studied in this connection.

Regarding research on the storage of gas, there is much to be learned about liquid storage and the relative economy and operating characteristics of this form of storage as compared to vapor storage.

The Engineering Group at the Gas Institute has two projects under way relating to gas transmission and distribution. The first of these is directed toward the development of a meter to detect and record temperatures at which gas hydrates may form in high-pressure transmission lines. The hydrate problem is of importance to almost all pipe-line operators. Dehydration of the natural gas being transmitted can eliminate the difficulty, but complete dehydration is an expensive process and can create other problems if not carefully controlled. The operation of a dehydration plant presents a problem in economic balance. Optimum dehydration is to that point at which the water-vapor content of the dehydrated gas is just insufficient to permit hydrate formation under pipe-line temperature and pressure conditions. Further removal of water vapor is not economical. Controlling a dehydration plant to this optimum can be accomplished either by continuous gas analysis and manual control, or by means of an automatic-control instrument. In developing a gas-hydrate meter the Engineering Group has in mind its future use as an automatic-control instrument. When the development of the gas-hydrate meter is completed, it may be found that present methods of dehydration-plant design will require revision. When sufficient operating data have been accumulated, the Engineering Group may be in an excellent position to guide future design.

Commonly engineering problems are masked by methods of cost accounting. A difficulty that lies basically in engineering may not appear to be a problem because methods of cost accounting fail to disclose an existing economic loss. Consequently, many companies are satisfied with their present method of operation; and what is a definite problem to one company is apparently no problem to another.

Purging operations on gas holders and pipe lines may be another such problem. The Engineering Group is beginning a survey of purging methods with the intent of clarifying and summarizing existing knowledge and then proceeding to develop methods based on sound engineering procedure.

As in the case of research on gas production, special emphasis will also be given at the Gas Institute to research in utilization, both domestic and industrial. The industry's many broad problems relating to utilization will be investigated as Institute-sponsored projects, and the narrower problems of primary importance to specific manufacturers will be circumvented except as they may be sponsored by the interested company or companies under the procedure established specifically for

sponsored research projects. In connection with domestic utilization, typical of the sort of research program which is being urged by the industry and which will be established shortly, is one on the development of a gas burner which will make possible the "capturing" of the products of combustion.

The industrial uses of gas are expanding rapidly. American manufacturers are learning in increasing numbers that gas is not only economical and that it readily lends itself to atmospheric control, particularly beneficial in heat-treatment, but also that gas equipment is relatively simple in construction and operation. The staff of the Institute is now considering the relative importance of various utilization projects which have been suggested, but actual work is still in the "literature search" stage.

SPONSORED RESEARCH PROJECTS

In respect to sponsored research projects, the Gas Institute operates much as an industrial-research institute. This division will undertake research projects relating to gas, fundamental or applied, which are "farmed out" to it by individual companies or groups of companies. The full cost of conducting this program is borne by the sponsoring companies. On the other hand, the work is carried on confidentially where desired, and patentable developments belong solely to the sponsor. Even member companies do not have access to data and reports. Full-time research workers alone are engaged on these projects. In order to secure maximum benefit for the underwriting sponsor, each project is generally guided by a Steering Committee which includes sponsor representation.

Sponsored research at the Gas Institute is rapidly increasing but it is the program about which the least can be said. Projects under way at the present time are sponsored by both individual gas-utility companies and equipment and appliance manufacturers. Permission has been granted to discuss two of the projects. Last January the Rochester Gas and Electric Corporation established a project entitled "The Removal of Organic Sulfur From Manufactured Gas." Subsequently the American Gas Association through the Organic Sulfur Subcommittee, of which Dr. E. W. Guernsey is chairman, established a project entitled "The Isolation and Identification of Organic Sulphur Compounds." Due to the close relationship of these problems, the sponsors have authorized an arrangement whereby the scientific staff of each is working in close coordination with the other, for the present time, to insure maximum progress. When the opportunities for mutualization diminish, each project will be reoriented and moved directly toward its objective.

In regard to the publication policies of the Institute, it might be explained that, because of the nature of the research projects conducted for individual sponsoring companies and for the supporting membership companies, publication of much of the work of the Institute is restricted. However, many of the projects are, and will be, of a nature that will allow broad publication. Each case will depend upon the circumstances.

One of the objectives of the Institute was to establish the main reference library of the gas industry. Toward this end a technical librarian with national reputation was appointed to supervise the services of this library. Already over 2000 valuable scientific reference volumes, foreign and domestic, have been acquired, and many new acquisitions are being made daily. The library's services comprise aid to the Gas Institute staff and students in literature and patent searching; current reviewing of literature on gas technology for the benefit of member companies; and miscellaneous bibliographical, translating, and abstracting services designed to make all publications on gas technology a living force in support of development and research.

CONCLUSION

In conclusion, it might well be stated that the research philosophy of the Gas Institute is that the gas industry cannot be served effectively by that type of "research" which consists solely of thinking up ways to take the other fellow's markets away from him. This can work both ways. The basic research which leads to fuller and more advantageous utilization of the nation's natural resources creates wealth instead of "robbing Peter to pay Paul," and this is the research which has always produced lasting benefit to its parent industry.

USE *of* MIXTURES *of* OIL *and* COAL *in* BOILER FURNACES

(*Continued from page 798*)

would be to purchase pulverized coal from plants that do not use their equipment at full capacity. This latter procedure would probably involve the transportation of the coal in pulverized form.

A survey should be made of oil-burning plants on the eastern coast to determine (1) if they already have the necessary equipment to burn coal; (2) if coal-burning equipment could be installed without rebuilding the furnace and boiler; (3) if an oil-coal fuel could be used without seriously reducing the boiler rating; or (4) if the boiler would be plugged by the ash from oil-coal mixtures. In the first case, the plant must burn coal if it has not already started to do so. In the second case, oil-coal fuel might be used until coal-burning equipment could be secured. In the third case, the composite fuel would help to conserve oil without interfering with operation, while in the fourth case, the boiler furnace would have to continue on oil or be shut down. This survey would require not only study of individual installations but actual tests with oil-coal mixtures as well.

In this report mention has been made of burning demonstrations with coal-oil fuel which have apparently been quite successful. There are three criticisms of the major portion of this work: The tests have usually been conducted on small boilers; the test time has been too short to be sure of the ultimate result; and there has been a distinct failure to observe or make public the details of the tests. These difficulties must be remedied to secure any widespread use of colloidal fuel.

ACKNOWLEDGMENTS

The information on which this paper is based was secured from the literature and from interviews with combustion and research engineers who have prepared or burned oil-coal mixtures. Their assistance is appreciated, for without it, the report would have been incomplete. The writer is particularly indebted to S. E. Sheppard, of the Eastman Kodak Company, for the description of his own work and that of the Submarine Defense Association.

LABOR'S ATTITUDE ON TECHNOLOGICAL CHANGE[1]

By W. RUPERT MACLAURIN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

READERS of MECHANICAL ENGINEERING should be interested in a study[2] which is published by the Bureau of Industrial Relations of the University of Michigan on managerial administration of technological change and workers' reactions to those changes. There has been a great deal of discussion in recent years of technological unemployment and the subject is still quite bitterly controversial. Professor Riegel's book does not attempt to measure the extent of technological unemployment. Instead, he has tried to find out how different types of companies have dealt with the problem.

Some of our early economic writers on technological progress and its effect on employment were inclined to dismiss the question as of no particular significance. They granted that some workers would be displaced by technical change but assumed that these would find positions readily in other industries. They pointed out that union attempts to control and oppose technological improvements had always resulted in failure and that from the workers' point of view the most sensible policy was to accept the fact of change and, if they were displaced, get a new job as rapidly as possible. It is perhaps unfortunate that these early economic writers had as much influence as they did. The general public came to believe that technological unemployment was not anything to worry about. It was true also that, until 1929, the fact that the United States was a rapidly expanding country with a growing population and undeveloped natural resources made it possible for displaced workers to be absorbed quite rapidly.

Our experience in the nineteen-thirties greatly altered public thinking toward questions of technological change. There can be no question any longer but what technological unemployment does occur and can create very severe hardship.

One example is an interesting illustration of the problem. The National Research Project of the W.P.A. made a study a few years ago of the effects of the introduction of machine methods of making cigars.[3] This was an extremely labor-saving device and resulted in very substantial displacement. The study concentrated on the experience of the displaced workers after the layoff. It showed that they had a very hard time indeed. Most of the hand cigar makers had been engaged in this particular trade for many years and had no other skills. It was very difficult, therefore, to absorb them in other occupations. As a result, they suffered extensive unemployment.

There have been numerous other cases of technological displacement which were not as severe as this. The facts are, however, that with the kind of industrial depression that we had in the thirties, where we were operating under less than full employment, seniority rights in the attachment to a job became extremely important. The loss of these rights through permanent technological displacement placed the unemployed worker in a very difficult position in getting another job, because he had no accumulated rights in any other company. Moreover, in many instances he would need considerable retraining before being absorbed.

The danger, of course, in a situation of this sort is that labor's reaction to technological change will become so adverse that progress will be seriously restricted, either by means of labor regulations in the collective-bargaining process or by legislation. It is obviously important, therefore, that management should take all steps possible to cushion the shock of technological change on the worker.

In view of the importance of this problem, it is heartening to find in Professor Riegel's book that progressive managements have been giving consideration to this question and in many cases have worked out methods of dealing with technological change which have proved satisfactory. Before discussing these solutions, however, we might refer to some of Riegel's findings concerning employee attitudes.

Professor Riegel writes: "To the extent that the 100 employees interviewed in the course of this study were typical, it can be said that workers normally fear and dislike technological change, and that these attitudes often cause them to resist it. Some of their common beliefs, which they deem well founded, are that technological changes displace workers, bring about part-time employment, reduce the values of changed jobs, cause established skills to become obsolete, increase strain and fatigue, and temporarily create accident hazards. . . Of importance also are their sentiments or feelings about insecurity for themselves and their families, the disturbance to their social status and associations, and the necessity of learning new skills and meeting new problems."[4]

Recognizing these attitudes, progressive companies, Riegel finds, have endeavored to time the installation of new machinery and equipment to minimize displacement. Some companies have scheduled installations so that most if not all of the persons displaced can be transferred to jobs made vacant by natural turnover. Managements also have attempted to maintain earnings of workers directly affected by technological changes. In some companies, for example, if a worker is transferred to a lower-paid job in order to avoid his total displacement, an attempt is made to reassign him as soon as possible to work which is as valuable as the work he was doing prior to his transfer. Other companies faced with the necessity of layoffs resulting from technological improvements have speeded up their retirement of infirm workers nearing the age of sixty five with special allowances which supplement their benefits under the Social Security Act. Where layoffs prove unavoidable, a good many companies provide dismissal compensation.

Professor Riegel feels that, in addition to direct steps of this sort, it is important that technological changes be introduced as diplomatically as possible. He stresses the importance of

[1] One of a series of reviews of current economic literature affecting engineering prepared by members of the department of economics and social science, Massachusetts Institute of Technology, at the request of the Management Division of The American Society of Mechanical Engineers. Opinions expressed are those of the reviewer.

[2] "Management, Labor, and Technological Change," by John W. Riegel, University of Michigan Press, Ann Arbor, Mich., 1942, 187 pp., $2.50.

[3] National Research Project on Re-employment Opportunities and Recent Changes in Industrial Techniques, "Cigar Makers—After the Layoff."

[4] P. 156.

the employment of superintendents, foremen, and technicians who fully appreciate the human problems associated with technological change. Incidentally, this is no easy task. Unfortunately, the technician is frequently inept and undiplomatic in his handling of human problems. This, of course, presents a challenge to the engineering schools and to the employers of engineers to overcome.

Riegel suggests that a personnel officer reporting directly to the chief production executive should represent employee interests in the deliberations of the technical planning committee of the business organization. His knowledge of contemplated technical improvements well in advance of their introduction is likely to lead to many detailed measures to conserve employee interests. Furthermore, adequate management-employee contacts should be maintained so that the employees can readily express their sentiments regarding technological changes to the managers.

"The employees directly concerned in a technological change should be informed as soon as feasible of managerial plans for maintaining their status, tenure, or earnings. Even if managers cannot provide such aid, they may be able to avoid future resentment by frankly discussing the probable results of the change with employees."[5]

In conclusion, Riegel hopes that any regulation of the introduction of new facilities may be made by private rather than public means, and that legislation on the subject will not be necessary. He does think, however, that a special section of the Public Employment Service should be started to deal with the problems of displaced workers. He suggests that this section, if staffed by men capable of exercising a large degree of initiative, could, upon notification of employers stating the qualifications of workers about to be displaced, inform them of other types of work requiring their qualifications, counsel the displaced workers with regard to additional training which would improve their employment prospects, and participate in the direction of public training agencies which provide such instruction. An additional aid "which can well be provided at public expense is the provision of retraining opportunities."

It may be necessary to go even further than Professor Riegel suggests. In the course of his book he quotes from the program of the Steel Workers Organizing Committee. This union group proposes for the future a program favorable to greater production and lower costs. The program, however, is to be based upon an agreement whereby the management will "share equitably with the union any benefits so obtained, in the form of increased employment, better working conditions, increased wages, or decreased hours. Nobody is to lose his job as a result of any improvement that is installed. If ways are discovered to do more work with less labor, they are to be put in gradually, and then only with the consent of the union. The research must be truly joint in every respect. All facts and plans are to be revealed to the union committee, and its understanding and consent must be obtained at every step."[6]

Whether or not it is desirable to go as far as this in union-management co-operation, I cannot but feel that workers should be laid off as a result of technological change only in extreme cases where this seems absolutely unavoidable. I believe that ultimately we shall have to come to a position where anybody who has to be laid off is given very substantial help until he can find another satisfactory job. Where it is at all possible, technological change ought to be introduced sufficiently slowly to avoid significant displacement, even though this means a sacrifice of material progress.

[5] P. 160.

[6] P. 125.

THE TIME OBSTACLE[1]

OF ALL the obstacles encountered by hopeful salesmen of goods, ideas, or personality, the one which has probably increased faster in importance than any other since Pearl Harbor is the "time obstacle." Symptoms of the operation of this obstacle are remarks such as the following: "I haven't time now," "I'll see you later," "I'm too busy at the present," or "I'll call you when I'm free."

To overcome this obstacle it is of prime importance for us to appreciate the importance of time ourselves. We may find plenty of proof of its importance in our own life every day. We are awakened by alarm clocks, we eat at certain times, board busses which run on a time schedule, punch a time clock when we get to work, and look at wrist watches, pocket watches, and wall clocks many times during the day. When work is finished, we go home and listen to radio programs whose beginning and end are fixed very rigidly by clocks. Practically our whole life is run by clocks.

This leads us to an implication of the modern golden rule—don't waste other people's time. If you do, you probably won't get a chance to do it again.

Time is like money. We can do just as we please with our own time but hate to have someone else spend it for us. We all have time enough to do anything, but not everything, so it is necessary to choose which things to spend our time on. Time is different from money in that we all have the same amount and this is limited to 24 hours each day, never any more. We have sugar and gasoline rationing now and may soon have many other things rationed. Time, however, has always been under one of the strictest rationing systems ever devised.

Of course, our approach depends upon each individual situation. A sick person in some hospital or a convict in his prison cell are likely to be hungry for company and enjoy the time spent with them. A busy executive, on the other hand, wants everything condensed to take up the shortest time possible. We may have to sneak our proposition in at some odd moment and must stick to the main points. If we feel that we cannot explain our ideas fully enough during the time given, we must interest our prospect enough to make him willing to grant us more time. Probably the best way to do this is to show him the importance of our propositions.

There is another sense in which time may be an obstacle. This involves the disposition of the prospect at the time addressed. If he is tired and hungry and his nerves are on edge, he will have "no" right on the tip of his tongue. Our chances of success would be much better if we approach him when he is rested and contented. Sometimes this isn't possible. Then we have to be especially careful not to irritate him further. A friendly approach, sincere compliments, and sympathy for his troubles all help us accomplish our purpose. Above all, remember the importance of time and act accordingly. Time is short; don't waste it.—E. C. LITSCHER.

[1] An essay by E. C. Litscher, University of Wisconsin 1941, written in connection with a course at the General Electric Company, Schenectady, N. Y., "An Engineering Approach to Human Relations."

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

The Great Waste

To the Editor:

What is our greatest waste today? Some say time, others say oil, food, water, paper. The writer believes it is coal, or rather the improper and uneconomically wasteful use of it.

The situation may not be so bad during the summer season, but certainly it is so in winter when many homes and business buildings are overheated and are without temperature control. The smoke nuisance in many towns is a clear indication of the wasteful use of coal.

Directly and indirectly smoke damage takes a toll in the health of a community where it exists; it lowers the value of goods in stores; house interiors are involved, where walls, draperies, and paints are adversely affected; the exteriors of houses and large buildings become deteriorated from its attack. All these effects are chargeable to smoke, while, in addition, a tremendous loss in heat value occurs wherever it is present.

The latter condition is vitally important when it is considered that only 50 or 60 per cent of the heat value in coal is being utilized in many instances, the remaining 40 or 50 per cent being blown out the chimney in the form of smoke. Certainly this represents an unnecessary burden of cost on our transportation system, and on our individual pocketbooks, particularly during the present time when a state of war exists.

Yes, we all know about it, but few seem to do anything to correct the condition. A few starts have been made here and there in this direction, but no real nation-wide effort has been made to alleviate the situation. We talk about, and actually do conserve oil and gasoline which are utilized much more economically than coal. Other combustible materials are also being burned economically; but coal, which now sells at retail at $8 or more per ton and no longer may be considered a cheap commodity, is still being handled wastefully.

Hence, the next question is how may we stop this waste of coal or at least obtain the best results from its use. This may be accomplished by the following means:

1 By improving our firing methods so that coal will be burned more completely and economically, at the same time accomplishing the elimination of smoke.

2 By utilizing the by-products of coal and, instead of burning coal, burn coke.

Burning Coke to Conserve Resources

The writer honestly believes that under the present war conditions the Government should put a stop to the use of coal as fuel wherever that is feasible and permit the use of coke only. Of course, that would not well be possible in homes using open fireplaces, but in boilers and furnaces, especially those equipped with stokers, by this means great savings could be realized. With slight modifications in the construction of the fireplace grate, coke could be burned successfully, resulting in a fine radiant heat, which would also eliminate the smoke evil inside and outside the house. Incidentally, lump charcoal also makes good fireplace fuel.

In some cases, it might be found necessary to modify the furnace construction of certain boilers, since coke does not fire readily, the heat liberated being more or less radiant. The furnace volume can be reduced in many cases without much trouble or expense.

Locomotives could use pressed coal or briquettes of a certain size. Such briquettes consist of a mixture of coke, coal, pitch, etc., the principal ingredient being coke. In the writer's opinion, briquettes may be much more efficiently handled by the fireman. A good gas coke burns well in a hot-air furnace, or home boiler equipped with stokers, or even when hand-fired.

It is the writer's opinion that one of the main reasons why coke is not used more widely in homes is the unfair price which dealers charge for it. At present the price is based on the carbon Btu value per pound of coke, although coke could be sold at or nearly at the same price as coal. It is true that the dealer has to pay more for freight in the case of coke than for coal, since coke is much lighter than coal. Consequently a railroad car would hold correspondingly less coke than coal by weight. After extracting all other commercial elements from the coal, refineries and gas companies could sell coke cheaper than coal since the coke is only a by-product. Actually the price of coke could be fixed by government regulation.

Better Utilization of Coal By-Products

The vital question now is, how can we use coal to better advantage, avoiding unnecessary waste and eliminating the smoke evil? How much greater utilization may be made of the by-products of coal than is now the case? First, we must realize that coal is a nonreproductive resource. When it is gone, it is not replenished.

Let us briefly consider what better utility may be made of bituminous coal, for example. The by-products of bituminous coal are the source of many valuable substances for the immediate as well as intermediate raw materials required in many processes, such as making dyestuffs, medical supplies, explosives, fuels, and other commodities too well known to require mention.

In the dry distillation of bituminous coal, we get (1) illuminating gas, (2) coal tar, (3) coke. Probably coal tar is the most valuable by-product since it constitutes a source of many valuable organic compounds, useful in many chemical industries. Illuminating or artificial gas is still used in localities all over the country where natural gas is not available. As a by-product of gas making, coke is used in foundries and steel mills, which could not do without it, and in many other places.

We know that, by the destructive distillation of coal tar, various condensates result, such as light oils, carbolic oils, phenols, cresylic acids, creosote oils, anthracene oils, pitch, ammonia, retort carbon, and some lesser products.

Light oil fractions plus light oil again can be split into crude benzene, toluene, solvent naphtha, heavy naphtha, wash oil residues, fuel oils. By crystallization, we get naphthalene, phenols, etc. But, we still retain practically all the carbonaceous material of the coal in the form of coke, while only the volatile matter is usefully recovered, which otherwise would blow out of our chimneys in the form of smoke.

We could easily supplement our present shortage of gasoline by benzene transformed into benzine. Furthermore, we get a large amount of ammonia, pitch,

cresolin antiseptics, such as phenol, creosote, etc., which are all of importance at the present time. The writer would not be surprised if someday, from this source, an immediate raw material might be discovered, which could be used as a substitute for rubber, because coal tar contains many elements, some of which at least offer possibilities in this direction. Therefore, there is no reason why illuminating gas should not be used more widely for power and heating purposes at present, even though its cost is greater than that of natural gas. Nearly every day chemists discover new products derived from coal.

Rather than go on making all the smoke we can, polluting our cities with it, and wasting 20 or 30 per cent of the heat value of the coal, the wider use of coke in homes and factories may be a present-day solution to greater economy. Also, wider utility must be made of the by-products of coal instead of letting them go up into the air in the form of smoke where they do nobody any good.

The writer believes that the government should place restrictions on the free use of coal, making the substitution of coke mandatory, wherever possible. The writer has a firm conviction that the improper use of coal constitutes one of the greatest wastes being committed in the national economy.

KARL ALDINGER.[1]

[1] Mechanical Engineer, Atlanta, Ga. Mem. A.S.M.E.

Vibration and Rubber Springs

COMMENT BY E. T. P. NEUBAUER[2]

This paper[3] constitutes a practical contribution to the art of isolation of vibration.

Regarding the use of rubber springs for isolation of vibration, a very important limitation must be considered. Because of the relatively small deflection obtainable with the average design of rubber springs, proper isolation is limited to a minimum frequency of about 700 cycles per min. By careful analysis of all the various degrees of freedom, rubber can be used successfully down to as low as 500 cycles per min. For the lower frequencies (300 to 500 cycles per min), due to the large static deflections required, the steel-coil spring is the most practical solution. However, because of the internal damping or hysteresis feature, rubber is the more desirable material to use wherever possible.

Another important point for the consideration of the vibration engineer is that the driving and driven units, wherever possible, should be rigidly mounted with respect to each other, and then the entire unit should be properly isolated. This is particularly true if the medium of power transmission is a belt or chain drive. Exceptions to this rule can be taken, but only with careful engineering, such as that illustrated in Fig. 4 of the paper, or the application of "floating power" in automotive design.

When an isolated mechanism passes through resonance, it has the tendency to produce large amplitudes of vibration. The control of this excess vibratory motion by the use of rubber bumpers, as suggested in the paper, may prove to be quite successful in relatively light units having supporting means with some internal damping. For the heavier mechanisms (10 to 50 tons or more), and particularly the lower frequencies, the application of bumpers, which are not in contact during normal operation, may present a serious problem. The instant the mechanism strikes these bumpers the form of vibration changes from harmonic to nonharmonic. This nonharmonic vibration may adjust its critical frequency by change of amplitude and thus follow the acceleration of the machine, resulting in vibration more serious than if no bumpers had been used. The most effective and reliable means of controlling the vibration, as the mechanism passes through the critical frequency, is to use a friction or other type damper which is designed to absorb energy without seriously changing the spring constant of the supporting means. Practical experience has shown that this vibration, when passing through the critical frequency, is not as serious as might be expected.

With the use of isolation factors 3 to 1 or 5 to 1, upon acceleration of the machine, the critical is passed so rapidly that there is insufficient time for serious vibration to develop. During deceleration, the vibration at critical frequency is built up at the expense of the kinetic energy of the moving parts, thus acting as a brake increasing the rate of deceleration, causing a more rapid passage through the critical frequency.

[2] Large Machine Development Department, York Ice Machinery Corporation, York, Pa. Mem A.S.M.E.

[3] "Vibration and Rubber Springs," by W. C. Keys, MECHANICAL ENGINEERING, March, 1942, pp. 175–180.

Spreader Stokers for Marine Boilers

COMMENT BY F. X. GILG[4]

The paper[5] presented by Mr. de Lorenzi is an interesting tribute to a simple inexpensive method of feeding and burning coal in a furnace. However, there is an inevitable refuse-carryover problem from the spreader- or flipper-type stokers which must be reckoned with, not only from the standpoint of the nuisance involved but also from the standpoint of efficient fuel burning.

A unit to be designed for spreader-stoker firing should be arranged to take care of large amounts of refuse carryover from the bottom of the boiler gas passes and should be equipped with automatic refuse-removal facilities, as otherwise these areas soon become choked up. Cinder catchers should be provided to avoid a stack-discharge nuisance. The refuse collected from these various sources may be reinjected into the furnace to recover some of the heat value from the unburned combustibles which would otherwise be lost. All of these things should be taken into consideration when comparing the qualities of the spreader stoker with other fuel-burning methods.

[4] Service Department, The Babcock & Wilcox Company, New York, N. Y. Mem. A.S.M.E.

[5] "Spreader Stokers Applied to Marine Boilers," by Otto de Lorenzi, MECHANICAL ENGINEERING, July, 1942, pp. 549–554.

COMMENT BY T. A. MARSH[6]

The author has made a valuable contribution to the science of applied combustion principles. He has mentioned the characteristics of spreader stokers which enable them to burn a wide variety of coals. This statement can be amplified. Successful and highly efficient operation of spreader stokers is being obtained with coals from the highest rank, semibituminous through all ranks, including subbituminous coal and lignite.

Another characteristic of spreader stokers is the ability to burn small-size coals. With spreader stokers that convey coal into the furnace by means of a stream of air, coals as small in size as $^1/_{10}$ in. to 0 in., and even dried washery sludge of a size approximately 48 mesh to 0, are being burned successsfully.

Spreader stokers are capable of maintaining a CO_2 content of gases as high as the furnace design and construction will

[6] National Industrial Engineer, Iron Fireman Manufacturing Company, Cleveland, Ohio. Mem. A.S.M.E.

permit. Continuous operation at from 15 to 16 per cent CO_2 is not unusual.

The loss due to carbon in refuse is also very low with the spreader stoker. Tests are on record with less than 0.1 per cent loss due to carbon in refuse, while maintaining a percentage of CO_2 above 15 in the exit gases.

The shallow fuel beds mentioned by the author permit pressures below the fuel bed very much lower than those required by thick fuel beds of other types of firing, thereby materially reducing auxiliary power required to operate the stoker, as compared to that required by stokers with deep fuel beds.

Spreader stokers, conveying coal pneumatically, have wide adaptability in that the stoker can be set 30 ft from the boiler front anywhere in a semicircle around the front. This is advantageous in application to boiler rooms, particularly where difficulties are encountered in designing or obtaining coal-handling equipment.

Comment[7] by W. T. Reid[8]

It is undoubtedly true that the spreader stoker is capable of burning a wide variety of coals, either caking or free-burning, largely because of the thin fuel beds normally maintained. It is also true that with stagnant ash the tendency to form clinker is less than when ash already accumulated is transferred to zones of high temperature by agitation of the fuel bed.

Spreader stokers, however, have been known to give trouble because of clinkering. With pin grates, the closing off of one opening by a small clinker deposit allows adjoining ash particles to overheat and aggravate the condition, resulting finally in a sheet clinker that may block off a relatively large area of the fuel bed. Clinker formation is the result of ash composition and temperature, and if the ash contains much CaO but is relatively low in Fe_2O_3, as many midwestern coals are, the reliance placed upon oxidation as a factor in the prevention of clinkering is misplaced and fusion of the ash is controlled only by time and temperature, the atmosphere surrounding the particle then being unimportant. Under these conditions, at temperatures as low as 1800 F, such ashes can fuse into objectionably strong units, and despite the method of burning or the arrangement of grates, fusion of the ash can be expected. Obviously, if the ash be maintained at temperatures well below 1800 F no clinkering will occur, but because ash in being released from the coal is heated to high temperatures, clinker formation is always possible with coals having ash of low fusion temperature.

Comment by C. J. Surdy[9]

From the discussion of this interesting paper one would get the distinct impression that the spreader-type stoker is of relatively recent origin. As a matter of fact, the principle of distributing coal over the fire bed in aerial paths has been used for many years in stokers for railroad locomotives. Up to the present time more than 15,000 locomotives have been equipped with stokers which distribute the coal over the fire bed from an elevated point of distribution.

Locomotive stokers do not employ the rotary fuel distributor, described by the author of this paper. Instead, the coal is delivered in front of a steam jet which, in conjunction with a distributor plate, distributes the coal evenly over the fire bed. There are some locomotive stokers in service which employ mechanically operated shovels for distributing the coal. However, the mechanical type of distribution has not proved as satisfactory for railroad service as the simple steam jet and distributor plate.

Comment by A. W. Thorson[10]

The author has mentioned the use of double-screened or nut coal as a fuel in some of his tests. It is ordinarily recognized that the maximum rating obtained with a given fuel is reduced when the fines are removed, and also that smoke very often results. The writer would like to know if he found these conditions.

Comment by J. F. Wood[11]

This paper bears out the experience which we have had with spreader-type stokers. In fact, the water-tube-boiler installation to which reference is made is on our steamer *Phipps*.

Very satisfactory results have been obtained with the use of spreader-type stokers on water-tube boilers installed on boats in our fleet. The average boiler efficiency will vary from 80 to 84 per cent in everyday operation, depending of course upon the fuel and the care with which the personnel handles the controls.

Maintenance costs are comparatively low, and we estimate they do not exceed the cost of furnace fittings and grate bars in the ordinary hand-fired boilers. Steady steam is maintained and the stokers respond very well to varying load conditions.

We have no difficulty in burning practically any type of ordinary stoker fuel which is available on the Great Lakes. However, the better the fuel the better the results are.

We have only one installation of the spreader-type stoker on a Scotch-boiler-equipped vessel. Here the results are not as good. The efficiency which we obtain from the Scotch boilers is about 5 to 10 per cent less than what we obtain with the water-tube boilers. This we attribute to the somewhat smaller furnace volume and the water-cooled surfaces in the furnaces and combustion chambers.

The spreader-type stoker burns a considerable portion of the fuel in suspension. With a small furnace volume and a considerable amount of fines in the coal, a large portion of the fines are carried through the boiler and out the stack as unburned carbon. This accounts for a considerable loss in the Scotch boiler. However, if larger-sized coal is used with very little fines, most of the fuel is consumed on the grates and much better results are obtained.

By the use of spreader stokers, we are able to reduce by one half the number of firemen required, and the labor of firing the boilers by the remaining firemen is considerably reduced, as compared to the old hand-fired methods. In general, the spreader-type stoker is a worth-while piece of equipment and materially reduces operating costs. They do, however, give much better results when operating under boilers having the proper furnace volume.

Author's Closure

The author appreciates the interest shown in the subject matter presented. Various discussions have added valuable comments which materially broadened the scope of the paper. However, a number of points have been raised and these may be advantageously expanded.

Mr. Gilg speaks of a "stack discharge nuisance." It is true that there is an increase in fly ash carry-over when spreader firing is used. The amount of carry-over is a function of coal sizing and furnace liberation rate. By including well-designed cinder traps in the boiler setting and also a workable cinder-recovery system it is possible to overcome much of this so-called nuisance. If a further reduction of stack discharge is desired, then some form of dust collector may be

[7] Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

[8] Acting supervising fuel engineer, Bureau of Mines, Central Experiment Station, Pittsburgh, Pa. Mem. A.S.M.E.

[9] Assistant to General Manager, The Standard Stoker Company, Inc., Erie, Pa. Mem. A.S.M.E.

[10] Assistant to the President, Carnegie Institute of Technology, Pittsburgh, Pa. Mem. A.S.M.E.

[11] Fleet Engineer, Pittsburgh Steamship Company, Cleveland, Ohio.

installed between the boiler outlet and the stack. Intelligent furnace design is a prerequisite of successful spreader or, for that matter, of any other type firing.

Mr. Marsh has very ably indicated the flexibility of the spreader with reference to range of coal size that may be burned. High CO_2 content in the furnace gases is quite normal with practically all coals. Low carbon loss in refuse is also characteristic. However, on this point a loss of 0.1 per cent is perhaps overoptimistic. The total loss due to carbon in ash pit and fly ash will seldom be lower than 1.0 per cent and frequently higher. It is the combination of ash-pit and stack discharge that must be considered in arriving at the carbon loss and not just the low loss due to carbon in the ash-pit refuse.

Mr. Reid speaks of clinker troubles with spreader firing. Much of this difficulty may be avoided by uniformly spreading the coal over the grate surface. A properly functioning automatic-control system will insure a fuel supply that quickly follows the steam demand. In this manner under- and over-feeding is avoided and clinker formations minimized. The grate design discussed and illustrated maintains its full air opening under operating conditions. Raising and lowering during dumping operation causes the individual grate elements to free themselves of dust or slag particles. Maintaining the air supply over the entire area reduces the formation of sheet clinkers.

Spreader firing originated with the first coal shovel. Mechanical spreaders are of later origin. Stokers applied to locomotives are of the induced- and not the forced-draft type. They do a grand job for the conditions under which they must operate. Forced-draft spreaders have been used in stationary installations for many years. Their application to marine boilers is of relatively recent origin, and it was to this fact that reference was made in the paper presented.

At this time it is not possible to fully answer the question raised by Mr. Thorson. Double-screened coal was not used in the tests referred to. However a statement was made that in some instances the use of double-screened coal made it possible to overcome a stack discharge nuisance. The question of coal sizing is receiving careful consideration in many stoker specifications. The size consist of any given coal will vary with its friability. Commercially available $^3/_4$-in. nut and slack is perhaps the most widely used and recommended fuel sizing.

The comments by Mr. Wood are based on years of fleet operation with many types of stokers. The seagoing spreader, without a question of doubt, is rendering a good account of itself.

The author at this point wishes to express his appreciation for the co-operation extended by Mr. J. F. Wood in making it possible to gather, at firsthand, the data presented. The boiler-room layout aboard the *Phipps* is compact, accessible, and requires a minimum of effort for good operation.

OTTO DE LORENZI.[12]

[12] Assistant General Sales Manager, Combustion Engineering Co., Inc., New York, N. Y. Mem. A.S.M.E.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Proceedings of Photoelasticity Conference

PROCEEDINGS OF THE THIRTEENTH SEMI-ANNUAL EASTERN PHOTOELASTICITY CONFERENCE. Edited by W. M. Murray, Massachusetts Institute of Technology. Reproduced by Lew A. Cummings Co., Cambridge, Mass. Paper, $8^1/_2 \times 11$ in., 130 pp., illustrated, \$2.

REVIEWED BY M. HETÉNYI[1]

FOR the last few years a noteworthy custom has been established by the individual universities sponsoring these photoelastic conferences in publishing the presented papers in the form of mimeographed collections. The present volume is the second contribution of this nature by the Massachusetts Institute of Technology under the able management of W. M. Murray and is by far the most voluminous which has appeared in this series, showing the increasing interest of photoelastic applications in the diverse technical fields.

The eighteen individual papers of this collection give a good over-all picture of the present state of photoelasticity. There is a great variety of problems and methods of approach; some papers deal with new applications of the standard technique while others pioneer in more novel and less established branches of photoelastic research.

In the field of standard two-dimensional analysis new investigations are offered by Dolan and Levine on curved beams, by Weibel and Coolbaugh on shrink-fitted members, by Frocht on the shear difference method, while there are two papers on structural problems by Rust and Polivka, respectively. Studies in dynamics are presented by Wyle with reference to vibrational and impact stresses, an inferometer of novel construction is advanced by Bubb, and fine patterns of principal stress lines are shown by Durelli by means of applying Stresscoat lacquer to photoelastic models.

In the three-dimensional field two papers are on the scattered-light method: Weller, the originator of the method, expounding its principles and Rosenberg attempting to apply it to shrink-fit problems. The transverse bending of plates with holes, a problem which cannot be handled by standard two-dimensional technique, is also treated by two papers: the first, by Lee, employs a reflecting layer in the neutral plane of the composite sandwich-type model, while the second paper, by Drucker, makes an ingenuous use of the stress-freezing technique and establishes for the first time the variation of the stress-concentration factors with the ratio of the hole diameter to the thickness of the plate.

The properties of some of the photoelastic resins are discussed in Frigon's report for the Material Research Committee of the Conference. There is also a short account by Dewey on studies of flow problems by means of streaming bentonite suspensions which become birefringent and exhibit the lines of constant velocity gradients in polarized light.

While each of the foregoing papers deals with some particular problem in the technique or application of photoelasticity, the collection also includes three papers of a more general nature, in which

[1] Mechanics Department, Research Laboratories, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Leaf of the Denver and Rio Grande Western Railroad, Lipton of the Chrysler Corporation, and Brahtz and Bruggeman of the Bureau of Reclamation describe the equipment of their respective laboratories. The last one of these papers gives a particularly comprehensive survey of the tools used by the photoelastic worker of today.

Mathematics Dictionary

MATHEMATICS DICTIONARY. By Glenn James and Robert C. James. The Digest Press, Van Nuys, Calif., 1942. Fabrikoid, $6^1/_8 \times 9$ in., 281 pp., illustrations, and tables, $3.

REVIEWED BY W. M. MURRAY[2]

A CONVENIENT reference book giving the names, symbols, and meanings of terms used in pure and applied mathematics. The scope of the book is wide enough to include many terms used in industry, commerce, and research. For this reason, it should be most useful in offices or libraries which are not equipped with large encyclopedias and for all occasions when only a short definition or explanation is required without a lengthy discussion. Where mathematical functions are described care has been taken to give both the representative symbols and a short description with supplemental diagrams in many cases. At the end of the book logarithmic, trigonometric, annuity, mortality, and arithmetic tables of squares, cubes, etc. have been included as well as a list of weights and measures. A fairly complete list of mathematical symbols and abridged tables of integrals and differentials have also been added to increase its value as a practical reference book or handbook.

Elements of Heat-Transfer and Insulation

ELEMENTS OF HEAT-TRANSFER AND INSULATION. By Max Jakob and George A. Hawkins. John Wiley & Sons, New York, N. Y., 1942. Cloth, $5^3/_4 \times 9$ in., 169 pp., illus., $2.50.

REVIEWED BY T. B. DREW[3]

THIS little book by Professor Jakob and Professor Hawkins is precisely what the authors say they intended it to be: An elementary presentation of the field of heat-transfer. The exposition of fundamentals is excellent. Breadth of coverage has been attained without entering into undue detail in special cases. Throughout, questions of units and dimensions have been carefully treated.

Somewhat more than one third of the text is devoted to conduction, including both the steady and the unsteady states. About the same space is given to convection, if one includes here the chapters on dimensional analysis and on Reynolds analogy. The remaining pages include not only solid-to-solid radiation, but also brief chapters on temperature measurement, and on the measurement of thermal conductivities and emissivities. The most notable omission is that of any treatment whatever of gas radiation.

The book is a valuable contribution to the student literature and, moreover, should commend itself to the nonspecialist seeking a brief elucidation of the heat-transfer field.

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[3] Associate Professor, Chemical Engineering, Columbia University New York, N. Y. Mem. A.S.M.E. and chairman, Heat Transfer Division.

Books Received in Library

AIRCRAFT ENGINE AND METAL FINISHES. By M. A. Coler. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1942. Cloth, $5^1/_2 \times 8^1/_2$ in., 128 pp., illus., diagrams, tables, $1.50. A brief description of current American practice in finishing the exterior surfaces of aircraft engines and similar parts is provided in this small book. It is intended for readers confronted by real problems but who have little knowledge of finishing procedures. Therefore much of the text is devoted to the principles underlying these procedures, with particular attention to organic finishes.

AIRCRAFT RIVETING, a Guide for the Student. By E. B. Lear and J. E. Dillon. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1942. Cloth, $5^1/_2 \times 8^1/_2$ in., 118 pp., illus., diagrams, charts, tables, $1.25. The subject of riveting is covered broadly, with emphasis upon certain practical aspects of its most important functions, and is presented in a volume of handy size.

AIRCRAFT YEAR BOOK FOR 1942, Twenty-fourth annual edition. Edited by H. Mingos, Aeronautical Chamber of Commerce of America, New York, N. Y., 1942. Cloth, 6×9 in., 693 pp., illus., diagrams, charts, tables, $5. The 1942 issue of this annual, like its predecessors, is intended to provide a record of all important happenings during the last year in aviation. An accurate, concise account of aviation's part in the war, of our army and navy air forces, of the government's part in training and education, and of government civil aviation forms a large part of the book. Air-transport facilities, private flying, civilian defense, airports, and airways receive due attention. Aircraft designs are shown and much statistical material is included.

BAUGHMAN'S AVIATION DICTIONARY AND REFERENCE GUIDE, Aero-Thesaurus. By H. E. Baughman. Second edition. Aero Publishers, Glendale, Calif., 1942. Leather, $6 \times 9^1/_2$ in., 906 pp., illus., diagrams, charts, tables, $6.50. This work presents in one volume a useful dictionary of terms and abbreviations used in aviation, a directory and a large amount of reference information upon flying, aircraft design, and aircraft production. The material included is eminently practical, and the book answers most ordinary questions very satisfactorily. The new edition has been thoroughly revised and enlarged by the addition of many new terms.

CALCULUS FOR PRACTICAL ENGINEERS. By A. Cibulka. Distributors, Hemphill's Book Store, Austin, Texas, 1942. Paper, 9×12 in., 100 pp., diagrams, tables, $3. A concise presentation of the fundamentals of differential and integral calculus, illustrated by numerous practical examples.

CHEMICAL REFINING OF PETROLEUM. (American Chemical Society Monograph Series No. 63.) By V. A. Kalichevsky and B. A. Stagner. Revised edition. Reinhold Publishing Corporation, New York, N. Y., 1942. Cloth, $6 \times 9^1/_2$ in., 550 pp., illus., diagrams, charts, tables, $7.50. This monograph is a comprehensive review of the literature of the chemical treatment of petroleum and its products. Treatment with sulphuric acid and with alkaline reagents, the use of adsorbents and solvents, antidetonants and inhibitors of oxidation, and gum formation are included. There are many bibliographic footnotes and extensive lists of patents. The new edition has been revised and in part rewritten.

COAL, presented by the President of the Board of Trade to Parliament by command of His Majesty, June 3, 1942. His Majesty's Stationery Office, London, England, 1942. Paper, $6 \times 9^1/_2$ in., 12 pp., tables (obtainable from British Library of Information, New York, N. Y., $.05). Describes the proposals for increasing coal output and for rationing household fuel.

DIESEL ENGINES, a Complete Diesel Home Study Course edited by L. H. Morrison and others. Diesel Publications, New York, N. Y., 1942. Cloth, $6 \times 9^1/_2$ in., 824 pp., illus., diagrams, charts, tables, $8. This volume provides the would-be Diesel engineer with a practical course of study, suited to self-instruction. The presentation is clear and simple and is largely descriptive and non-mathematical.

ELECTRIC POWER STATIONS, Vol. 2. By T. H. Carr, with a foreword by Sir L. Pearce. D. Van Nostrand Co., Inc., New York, N. Y., 1941. Cloth, $5^1/_2 \times 9$ in., 440 pp., illus., diagrams, charts, tables, $9. The aim of this two-volume English book is to provide an account of the general principles that govern the design, construction, and operation of electric power stations, which will assist the designer to choose, from the plant available, that which best fulfills the conditions to be met, and to arrange it in the most economical way. The present volume deals with the electrical equipment and station organization and costs.

ELEMENTARY STRUCTURAL ANALYSIS AND DESIGN, Steel, Timber and Reinforced Concrete. By L. E. Grinter. The Macmillan Company, New York, N. Y., 1942. Cloth, $6 \times 9^1/_2$ in., 383 pp., illus., diagrams, charts, tables, $3.75. A brief, simple treatment of the subject intended for students of architecture and mechanical and electrical engineering and others interested in buildings and miscellaneous structures but not in bridge design. While greatest emphasis is placed on steel structures, considerable attention is given to reinforced concrete, and timber is treated adequately. Special chapters on timber roof trusses and on column footings are included.

ELEMENTS OF PRACTICAL AERODYNAMICS. By B. Jones. Third edition. John Wiley &

Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1942. Cloth, 6 × 9¹/₂ in., 459 pp., illus., diagrams, charts, maps, tables, $3.75. This is a simple exposition of the subject intended for classroom use. This edition has been revised and rearranged and new material has been added.

ENCYCLOPEDIA OF AMERICAN HAND ARMS. By G. M. Chinn, Jr., and B. E. Hardin. Standard Printing and Publishing Company, Huntington, West Virginia, 1942. Cloth, 8 × 11 in., 349 pp., illus., $8. This book contains illustrations and descriptions of nearly seven hundred pistols and revolvers of American manufacture and of dates from the early eighteenth century to today, with the names of their makers. It also contains a glossary of gun parts, an extensive list of American and foreign makers of hand arms, a list of trade names, and one of American patents. The book will be useful to collectors and historians.

Great Britain, Ministry of Home Security, Home Security Circular No. 75/1942. SHELTER DESIGN AND STRENGTHENING—CONSOLIDATING CIRCULAR. His Majesty's Stationery Office, London, England, 1942. Paper, 8¹/₂ × 13 in., 21 pp., diagrams (obtainable from British Library of Information, New York, N. Y., $0.30). Modified designs for "standard" shelters are given, which afford a much greater degree of protection at small increase in cost. Methods of strengthening existing shelters are also described.

HANDBOOK OF MECHANICAL DESIGN. By G. F. Nordenholt, J. Kerr, and J. Sasso. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Cloth, 8¹/₂ × 11 in., 277 pp., diagrams, charts, tables, $4. This volume, the material of which has appeared previously in *Product Engineering*, presents practical methods and procedures which have been in use in engineering designing departments. Chapters cover: Charts and tables for general arithmetical calculations; the properties of materials; beams and structures; latches, locks and fastenings; springs; power-transmission elements and mechanisms; drives and controls; and design data on production methods. The information is chiefly presented as charts, nomograms, and tables and in several hundred excellent drawings.

HANDBOOK OF SHIP CALCULATIONS, CONSTRUCTION AND OPERATION. By C. H. Hughes. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Leather, 5 × 7 in., 558 pp., illus., diagrams, charts, tables, $5. This reference work brings together conveniently a large amount of practical information frequently wanted by those who design, build, and operate ships. The new edition has been thoroughly revised and largely rewritten.

HEAT TRANSMISSION. By W. H. McAdams. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Cloth, 6 × 9¹/₂ in., 459 pp., illus., diagrams, charts, tables, $4.50. In this volume which is sponsored by the National Research Council, the fundamentals of heat transmission are presented in form for study and for reference. The available data have been collected from all sources, reduced to a common basis and correlated, and the results presented in formulas and graphs for use in engineering design. This edition incorporates much new material accumulated during the last decade. There is a bibliography of nearly eight hundred papers.

HYDROLOGY. (Physics of the Earth—IX.) Edited by O. E. Meinzer. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Cloth, 7 × 10 in., 712 pp., illus., diagrams, charts, maps, tables, $7.50. This is the final volume of a series of monographs prepared under the direction of a committee of the National Research Council. The series covers the physics of the earth and aims "to give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status, together with a forward-looking summary of its outstanding problems." The present volume on hydrology first describes the two basic processes, precipitation and evaporation. The processes of storage and transfer of the water are then treated at length and followed by a chapter on the physical and chemical work done by the natural waters in the course of their circulation. Chapters are devoted to the hydrology of limestone and lava-rock terranes. Each chapter has a bibliography.

INDUSTRIAL CAMOUFLAGE MANUAL. By K. F. Wittmann. Reinhold Publishing Corporation, New York, N. Y., 1942. Paper, 8¹/₂ × 11 in., 128 pp., illus., diagrams, tables, $4. This interesting book presents experiments and experiences developed in the classrooms and camouflage laboratory of Pratt Institute. The presentation is largely by drawings and photographs. Principles, methods, and materials are described and demonstrated on models and by actual installations.

INDUSTRIAL FURNACES, Vol. 2. By W. Trinks. Second edition. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1942. Cloth, 6 × 9¹/₂ in., 351 pp., illus., diagrams, charts, tables, $5. As in the first edition of this well-known treatise, this volume is devoted primarily to practice and is intended especially to aid in the selection, installation, and operation of furnaces. The discussion covers fuels and sources of heat energy, combustion devices and heating elements, control of furnace temperature and atmosphere, labor-saving appliances, and the comparison of fuels and types of furnaces. Much of the book has been rewritten to include new developments.

INDUSTRIAL MANAGEMENT. By A. G. Anderson, M. J. Mandeville, and J. M. Anderson. Ronald Press Co., New York, N. Y., 1942. Cloth, 6 × 9¹/₂ in., 612 pp., illus., diagrams, charts, tables, $4.50. This text is a revision of "Industrial Engineering and Factory Management," in which the emphasis has been shifted from technical and labor problems to the relations that exist between industry and society as a whole. Starting with a presentation of the contacts of a company with the public, the work describes the development of industrial management, the organization of a company, the location, construction, and equipment of the plant, product simplification and standardization, relations with employees, and control devices for waste elimination and co-ordination of activities.

INTRODUCTION TO CONTROL ENGINEERING. By E. S. Smith. Apply to author, 114–57 176th St., St. Albans, Long Island, N. Y., 1942. Paper, 8 × 11 in., paged in sections, diagrams, charts, tables, $2, including separate pamphlet of figures. These notes represent lectures on control and its applications in the process industries, given by the author for an Engineering, Science, Management, and Defense Training course at Pratt Institute. The book is intended for those actively working with industrial measuring and controlling instruments and is intended as an introduction to the basic principles that underlie the solution of specific problems.

Introduction to the THEORY OF ELASTICITY for Engineers and Physicists. By R. V. Southwell. Second edition. Oxford University Press, New York, N. Y., 1941. Cloth, 6 × 9¹/₂ in., 509 pp., illus., diagrams, charts, tables, $10. The first edition, which appeared in 1936, was intended to provide a text for students pursuing advanced studies in elasticity and for engineers who needed a wider knowledge of elastic theory than was demanded formerly, to deal with the problems arising from higher speeds in machinery, the use of light metals in structures, etc. This edition is substantially a reproduction of the first, with the correction of a few errors and some minor additions.

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MACHINE SHOP PRACTICE. (Rochester Technical Series.) By S. B. Hagberg in collaboration with M. S. Corrington and R. M. Biehler. Harper & Brothers, New York, N. Y., and London, England, 1942. Cloth, 8¹/₂ × 11 in., 311 pp., illus., diagrams, charts, tables, $2.50. This textbook is one of a series developed at the Rochester Athenaeum and Mechanics Institute as a part of its program for developing teaching materials which are practical in nature and closely related to the actual requirements of various jobs in industry. It is a shop workbook, intended to be used at the machine or bench by the student, which provides a series of projects of increasing difficulty which will enable the student to master the fundamental processes and skills involved in machine-shop work.

MACHINE SHOP YEARBOOK AND PRODUCTION ENGINEERS' MANUAL, edited by H. C. Town, foreword by Sir A. Herbert. Paul Elek Publications, Africa House, Kingsway, London, W.C.2, England, 1942. Cloth, 5¹/₂ × 8¹/₂ in., 558 pp., illus., diagrams, charts, tables, 25s. The first issue of what is planned as an annual reference book on engineering practice, this volume presents a variety of useful information. The first section consists of a number of articles on timely topics, such as machinability, diamond tools, and grinding by well-known specialists. Section two is a review of established practice in machine work, illustrated by descriptions of typical machines. The final section contains extensive abstracts of important recent papers on materials, heat-treatment, testing, machinery, etc. selected from American and European journals.

MANUAL OF MOMENT DESIGN. By J. Singleton. American Institute of Steel Construction, New York, N. Y. H. M. Ives & Sons, Topeka, Kansas, 1941. Fabrikoid, 7 × 10 in., 146 pp., illus., diagrams, charts, tables, $4. This book is intended to provide the designer

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with a ready method of calculating the bending moments in prismatic continuous beams and frames, and to eliminate much of the drudgery of computation. The user is assumed to be conversant with the theory of continuity.

MARINE POWER PLANT. By L. B. Chapman. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Cloth, 6 × 9½ in., 401 pp., illus., diagrams, charts, tables, $4. Intended for the practical man as well as for the student, this book is restricted to fundamental principles, with a minimum of descriptive matter and details. It presents the thermodynamics of the marine power plant and the types of machinery used for ship propulsion, and gives a comprehensive idea of the layout and function of the various pieces of auxiliary machinery. Complete calculations for boilers and auxiliaries of a typical plant are included.

MERCHANT MARINE OFFICERS' HANDBOOK. By E. A. Turpin and W. A. MacEwen. Cornell Maritime Press, New York, N. Y., 1942. 740 pp., illus., diagrams, charts, tables, $5. This handbook has been prepared to give the essential information required for the new examinations of the Bureau of Marine Inspection and Navigation, and also to serve as a practical reference book for use at sea. Navigational instruments, piloting, tides and currents, cargo, ship handling, signals, and other important subjects are covered. The rules of the road are included. Appendixes contain mathematical formulas and tables.

MODERN CORE PRACTICES AND THEORIES. By H. W. Dietert. American Foundrymen's Association, Chicago, Ill., 1942. Cloth, 6 × 9½ in., 532 pp., illus., diagrams, charts, tables, $5 to members of A.F.A.; $8 to nonmembers. This volume presents a series of lectures delivered at the 1941 and 1942 conventions of the American Foundrymen's Association. It aims to make available in one place all the existing technical and practical information on core-making. Core ingredients and the methods of mixing them, core forming and baking, preparing cores for the mold, and their setting and holding are described. Casting defects caused by the core are discussed and remedies suggested. There is a bibliography.

"PARTICLES" OF MODERN PHYSICS. By J. D. Stranathan. Blakiston Co., Philadelphia, Pa., 1942. Fabrikoid, 6 × 9½ in., 571 pp., illus., diagrams, charts, tables, $4. This book presents the material essential to an appreciation of modern physics and the newer concepts of atomic structure. The experimental evidence upon which each concept is founded has been stressed throughout. The book is intended both as a fundamental text in its field and as a reference work for advanced students, for which purpose a large number of specific references have been included as footnotes.

PETROLEUM AND NATURAL GAS ENGINEERING, Volume 1, 536 pp., $3. PETROLEUM REFINING, Volume 2, 522 pp., $3. PETROLEUM REFINING, Volume 3, 419 pp., $3. By M. M. Stephens. The Pennsylvania State College, Division of Mineral Industries Extension, School of Mineral Industries, State College, Pa. Vol. 3, 1939; Vols. 1 and 2, 1941. Fabrikoid, 6 × 9 in. illus., diagrams, charts, maps, tables. These volumes present a three-year course of study for men employed in petroleum refining and allied industries, which is adapted for use by employee groups under teachers or for self-instruction. It represents the extension course of The Pennsylvania State College. Volume one contains the fundamental mathematical, physical, and chemical principles necessary for the later volumes; volume two discusses the basic refining processes, and volume three describes their more technical phases.

PHYSICS FOR ENGINEERS. By Sir. A. Fleming. Chemical Publishing Co., Brooklyn, N. Y., 1942. Fabrikoid, 5½ by 9 in., 232 pp., illus., diagrams, charts, tables, $3. Present-day knowledge in the realm of physics is summarized with special reference to the requirements of practical engineers. The book starts with the fundamental physical units and ends with atomic transformations, having dealt with various aspects of energy, electricity, electronic emissions, radiation, optics, and sound.

PRACTICAL CONSTRUCTION OF WARSHIPS. By R. N. Newton. Longmans, Green & Co., London, England, New York, N. Y., and Toronto, Canada, 1941. Cloth, 6½ × 10 in., 318 pp., illus., diagrams, charts, tables, $6. This textbook is based on courses at the Royal Naval Engineering College and the Royal Naval Dockyard and replaces an older text by N. J. McDermaid, "Shipyard Practice as Applied to Warship Construction." It deals with the principles of construction and erection of the structure and the more important ships' services of modern warships. Chapters on launching, docking and undocking, and on the prevention of corrosion are included.

PRECISION MEASUREMENT IN THE METAL-WORKING INDUSTRY, issued by the New York State Education Department, a reprint of "Measuring Instruments," a Manual of Instruction prepared by the Education Department of the International Business Machines Corporation, Endicott, N. Y., 1941. Cloth, 10×11½ in., 496 pp., illus., diagrams, charts, tables, $3.75. Roy F. Johncox, Vocational High School, Rochester, N. Y. This manual was prepared for use in the factory-training program of International Business Machines Corporation. Opening with a general statement on measurement, successive chapters are devoted to nonprecision line-graduated instruments, precision gage blocks, plug, ring, and snap gages, thread gages, dial gages, and test indicators, micrometers and verniers, surface plates and accessories, angle measuring instruments, comparators, optical instruments and surface finish measurement, and measuring machines and hardness testers. The construction and uses of these devices are explained in clear, simple language, profusely illustrated by admirable photographs and drawings, providing an excellent course of instruction.

STORY OF THE AIRSHIP (Nonrigid), a Study of One of America's Lesser Known Defense Weapons. By H. Allen. Goodyear Tire & Rubber Co., Akron, Ohio, 1942. Cloth, 6 × 9½ in., 74 pp., illus., diagrams, maps, tables, $1. This volume, published by the Goodyear Tire & Rubber Company, reviews the history of the airship and the part it played in the first World War. Improvements since that time are also described, and the ways in which airships can be of special use today are pointed out. Attractive photographs add to the interest of the work.

TABLES OF PHYSICAL AND CHEMICAL CONSTANTS and Some Mathematical Functions. By G. W. C. Kaye and T. H. Laby. Ninth edition. Longmans, Green & Co., New York, N. Y.; London, England; Toronto, Canada, 1941. Cloth, 6½ × 10 in., 191 pp., tables, $5. This well-known publication aims to fill the need for an up-to-date moderately priced collection of physical and chemical tables which will meet the usual needs in teaching and laboratory work. The new edition has been thoroughly revised and expanded.

TECHNIQUE OF EXECUTIVE CONTROL. By E. H. Schell. Fifth edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1942. Cloth, 5 × 7½ in., 252 pp., $2. This book defines the tools of executive control, outlines the factors involved in the successful handling of others, and gives practical methods for getting a maximum output of work with a minimum amount of friction. The equally important factors of maintaining cordial and mutually helpful relations with associates and superiors also receive detailed consideration. A new chapter, "Executive Conduct and the National Effort," shows the influence of the war on executive technique.

TIN SOLDERS: a Modern Study of the Properties of Tin Solders and Soldered Joints. (Research Monograph No. 1.) By S. J. Nightingale with an introduction by R. S. Hutton. Second edition. Revised by O. F. Hudson. British Non-Ferrous Metals Research Association, Euston St., London, N.W.1., 1942. Cloth, 6 × 10 in., 117 pp., illus., diagrams, charts, tables, 10s, 6d, (in U. S. A., $2.75). Since the appearance of the first edition of this book in 1932, further investigations have been carried on by the Association, mainly upon the creep properties of solders and soldered joints, the results of which are incorporated in this edition. The first section of the book deals with the constitution of the tin solders; their structure; the mechanical properties of the solder alloys; the strength of soldered joints; creep properties of solder alloys and soldered joints; and alloying between the solder and the joint members. The second part discusses such practical considerations as fluxes, spacing, wiped joints, and the choice of a solder.

UNITED STATES TENNESSEE VALLEY AUTHORITY, THE CHICKAMAUGA PROJECT. (Technical Report No. 6.) Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn., 1942. Cloth, 6 × 9½ in., 451 pp., illus., diagrams, charts, maps, tables, $1. Facts concerning the planning, design, construction, and initial operations of the Chickamauga project of the Tennessee Valley Authority are presented in this report. Unusual and unprecedented features and methods are described in some detail, while common procedures and practices receive rather brief treatment. Chapter bibliographies, a section on costs, and a statistical summary are included.

VOLUMETRIC ANALYSIS, Vol. 1. Theoretical Fundamentals. By I. M. Kolthoff and V. A. Stenger. Second revised edition. Interscience Publishers, New York, 1942. Cloth, 6 × 9½ in., 309 pp., diagrams, charts, tables, $4.50. The theoretical considerations underlying the methods of volumetric analysis are comprehensively discussed. Basic principles are stated for neutralization, ion combination, and oxidation-reduction reactions. The operation and utilization of various types of indicators are considered. The later chapters deal with special considerations, such as adsorption and coprecipitation phenomena and various methods for the determination of the equivalence point.

WHAT STEEL SHALL I USE? By G. T. Williams. American Society for Metals, Cleveland, Ohio, 1941. Cloth, 6 × 9 in., 213 pp., illus., diagrams, charts, tables, $3.50. The many factors which bear upon the selection of the best available steel for any given purpose are briefly and clearly presented. These factors include physical properties, metallurgical aspects, availability of proper treatment, considerations in fabrication, and economic aspects. Suggestions for further reading accompany each chapter.

A.S.M.E. NEWS

And Notes on Other Engineering Activities

Man Power, Women in Industry, and War Production Featured at 1942 A.S.M.E. Fall Meeting, Rochester, N. Y., Oct. 12–14

PROBLEMS of war production, salvage, and man power, particularly that phase which involves the employment of women in industry and in engineering posts, engaged the attention of 500 engineers at the 1942 Fall Meeting of The American Society of Mechanical Engineers at the Hotel Sagamore, Rochester, N. Y., Oct. 12 to 14.

Special features of the meeting, which, combined with a varied and attractive program of technical papers, made it an important occasion, were the program of the Wood Industries Division, the meeting of the A.S.M.E. Executive Committee with members of the Council, the conference of local section delegates of Group III, four addresses of a highly informational and inspirational character delivered at luncheons on Monday, Tuesday, and Wednesday and at the dinner on Tuesday evening, a get-together social hour for early arrivals on Sunday evening, a program for the women attending, and three afternoons devoted to plant trips to many famous Rochester industrial plants.

Group III Section Delegates Meet

For members of the Council and for the delegates of local sections in the Group III area, Sunday was a busy day. Business to be conducted kept both bodies until long after the regular dinner hour in order to complete their extensive agenda. President Parker presided at the Executive Committee meeting and Carl Schabtach held the delegates to a businesslike consideration of all the questions prepared in advance for discussion.

Program and News of the

1942 ANNUAL MEETING

will be found in the Special Insert Section pages 831–842

Wood Industries Division's Program

Following a practice that has worked successfully for several years, the Wood Industries Division held its annual national meeting concurrently with the technical sessions that made up the general Society program. On Monday morning, with Sern Madsen presiding, the division discussed papers on the effect of wood structure upon heat conductivity; the making of plywood with multidirectional pressure, by means of which structures, such as boat hulls and aircraft parts, are built up of thin sheets of wood held together by resinous adhesives; and high-density plywood, a material formed under high pressure into such parts as airplane propellers.

Papers presented at the Divisions' afternoon session afforded additional evidence of the high quality of engineering that is being applied to the problems of the wood industries. An analysis was reported of the factors responsible for the raised grain of the wood of oak following sanding and staining operations. The behavior of plywood under repeated stresses as observed under a research project as yet uncompleted was described. Results so far announced indicate that fatigue failures are primarily wood failures and that the material may be expected to withstand at least two million reversals without parting when it is stressed to 25 per cent or less of the static modulus of rupture.

The third paper described the heating of wood with radio-frequency power. It was shown that the time necessary to bring the wood to the desired temperature for gluing and bonding is only a small faction of that needed when steam heating is used and that the temperature distribution is much more uniform. The process was explained and its limitations discussed.

Under the guidance of Thomas D. Perry, who served as chairman, a lively and informative discussion developed that demonstrated the keen interest, accentuated by the present spur of necessity to discover substitutes for metals, that meetings of the Wood Industries Division are stimulating.

Nelson C. Brown Talks on Importance of Wood

The Wood Industries Division also provided the speaker at the luncheon on Monday at which Virgil Palmer, general chairman of the Rochester Committee, presided. After he had welcomed A.S.M.E. members to Rochester, Mr. Palmer reviewed briefly previous meetings held on behalf of the Society by the Rochester section and referred to Miss Kate Gleason, first woman member of the A.S.M.E. and one of the pioneer women in engineering in this country. He introduced William H. Hutchins, president of the Rochester Engineering Society, who extended a brief but warm welcome to A.S.M.E. members, and James W. Parker, president of the A.S.M.E.

Thomas D. Perry then introduced the luncheon speaker, Prof. Nelson C. Brown, State College of Forestry, Syracuse University, whose subject was "Wood, the Most Important Raw Material of the Future." Professor Brown made an informative and convincing defense of his thesis. He described new developments, and, calling attention to the W.P.B. ban on the manufacture of nearly 1000 items made of steel and other metals, he said that wood was being called upon to take their places and was "likely to become more important to civilization than metals, oil, rubber, and ceramic products." He aroused great interest by his references to the use in Europe of wood gas as a fuel for automobiles, trucks, and busses, called attention to the use of wood in the manufacture of explosives, clothing, and even food, and told how compressed plywood was displacing metals in many instances.

On Monday evening the Wood Industries Division closed its program with a dinner.

Man Power and Women in Industry

Perhaps the most timely and interesting group of papers and discussions concerned man power and the use of women in industry as workers and engineers. Under the sponsorship of the Committee on Education and Training for the Industries and the Management Division, three sessions were held, all of which attracted interested audiences and provoked favorable comment.

With A. R. Stevenson, Jr., chairman of the

Committee on Education and Training for the Industries, presiding, the first session on women in industry was held on Monday morning. The experience of Stevens Institute of Technology in training women for engineering posts was described by Robert H. Baker and Mrs. O. S. Reimold, of the War Industries Training School of the Institute. It was found that few women apply for training in engineering subjects and reasons given for this were less interest in engineering, lack of training for engineering study, and less aptitude in basic subjects.

This paper was followed by an able presentation of the factors influencing women in engineering, by Mrs. Lillian M. Gilbreth. Discussion of the two papers by men and women in educational, engineering, industrial, and personnel fields covered a wide range of points of view and experience. It was pointed out by Harvey N. Davis of Stevens Institute of Technology that with the reduction of the draft age to 18 years, 90 to 95 per cent of the freshmen in engineering colleges will be drafted or will join the reserves so that industries cannot expect to recruit young men for the duration of the war. This means, he said, that work in progress on the drafting board can be put through, but by 1944 the nation will fall behind in the steady improvement of its military equipment. This condition implied the need to train women for engineering position, preferably college graduates with a background of mathematics and physics. Was Stevens foolish in trying to train such women, he asked.

The second session sponsored by the Committee on Education and Training for the Industries took the form of a panel discussion on education for industry, with Carl L. Bausch as chairman. It was concluded on time to hear the President's address to the Nation on Monday night. Discussion leaders who comprised the panel were introduced by Mark Ellingson, president of the Rochester Athenaeum and Mechanics Institute of Rochester. Each member of the panel described the training work of his own organization. In addition to Mr. Ellingson the discussion leaders were: S. C. Hollister, dean of engineering, Cornell University; Verne Bird, assistant superintendent in charge of vocational education, Rochester Public Schools; Ralph C. Welch, chairman of the Training Committee of the Industrial Management Council, Rochester; L. J. Fletcher, director of Training, Caterpillar Tractor Company, Peoria, Ill.; R. L. Goetzenberger, vice-president, Minneapolis-Honeywell Regulator Co., Philadelphia; M. J. Kane, Training Within Industry, W.P.B., Washington, D. C.; and Emile J. Pelletier, Bell Aircraft Corporation, Buffalo, N. Y.

Women In Industry

Under the auspices of the Management Division and with J. M. Talbot serving as chairman, a session on Women in Industry completed the discussion of the man-power problem. Dr. Leonard Greenburg, executive director of the Division of Industrial Hygiene, State of New York, presented an important paper on the physical, physiological, and psychological differences between men and women which should serve as a guide to employers contemplating the hiring of female workers. The animated discussion of Dr. Greenburg's paper introduced many important problems, such, for example, as wage differentials.

Following Dr. Greenburg, L. L. Park, superintendent of Welfare, American Locomotive Company, spoke on the experiences of employing women in the shops of the Montreal Locomotive Works, Limited, in Canada, where, since the middle of 1941, four hundred women have been employed on 19 different jobs.

Many Technical Papers Read

Time and space do not suffice to record the subjects presented in many technical papers that constituted the programs of the other sessions of the meeting. Divisions sponsoring these sessions were Fuels, Aviation, Power, Production Engineering, Industrial Instruments, and Materials Handling.

On the concluding day the Management Division sponsored its second session at which the subject was industrial salvage. Geo. Sutherland, Regional Conservation Manager, Conservation Division, W.P.B., New York, N. Y., served as chairman and the speakers were B. D. Kunkle, vice-president, General Motors Corporation, Detroit, Mich., and Robinson D. Bullard, Reclamation Engineer, Bullard Company, Bridgeport, Conn.

Walsh Speaks on "Science of Survival"

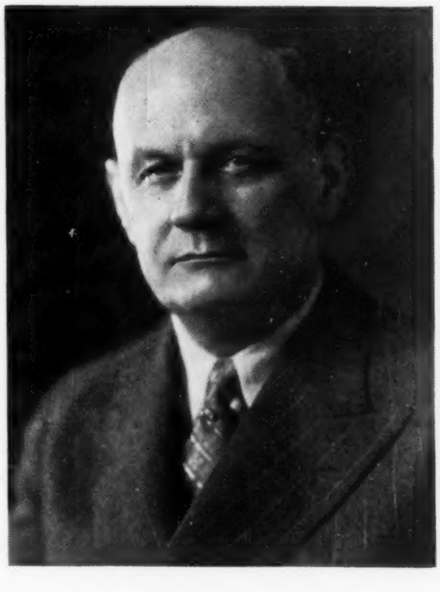
At the Tuesday luncheon, at which Wallace D. Wood, chairman, A.S.M.E. Rochester Section, presided, the speaker was Col. James L. Walsh, chairman, A.S.M.E. War Production Committee. Colonel Walsh's subject was "The Science of Survival." His address was a stirring appeal for wholehearted all-out effort of every citizen in the winning of the war, and it contained also a brief report of the activities of the A.S.M.E. War Production Committee.

R. B. Woodward Addresses Students on the Character of a Profession

Speaking at the Wednesday luncheon, at which Howard Harding, technical engineer, Rochester Gas and Electric Company, was chairman, Roland B. Woodward, senior regent, chairman of Committee on Higher Education, University of the State of New York, had as his subject "Engineering as a Profession." In view of the fact that Dr. Woodward found himself facing more than 100 students from Cornell University, the University of Rochester, and the Rochester Athenaeum and Mechanics Institute, he abandoned his prepared paper and spoke with inspired sincerity on the responsibilities of a profession. Going back over the history of the British craft guilds, Dr. Woodward showed how they had disappeared because they failed to serve the public. On the other hand the professions, which had devoted themselves to public service, had grown and prospered.

Canadian Minister of Labour Banquet Speaker

The speaker at Tuesday night's banquet was the Honorable Humphrey Mitchell, Canadian Minister of Labour, Ottawa, Canada, who was introduced by the toastmaster, H. H. Sullivan, president, Paragon Revolute Corporation and H. H. Sullivan, Inc., of Rochester.



HUMPHREY MITCHELL

Mr. Mitchell described the Canadian war effort in the military and industrial fields and the attempts resorted to in Canada to peg prices and stabilize wages in order to avoid inflation. On December first, he announced, the Ministry of Labour will assume complete control of man and woman power in Canada.

The Minister's comments on the status of engineering students greatly interested all present. He said in part:

"The decision was made not to accelerate the courses for engineers, as practical experience gained in industry during the long summer vacation was considered an essential part of their training.

"The Wartime Bureau of Technical Personnel, however, undertook to arrange summer employment along the line of their training for all engineering students."

Many Rochester Plants Visited

Visits to nine Rochester plants were arranged for the afternoons of Monday Tuesday, and Wednesday. The plants visited were the Rochester Athenaeum and Mechanics Institute, University of Rochester, Men's Division, Thomas Edison Technical High School, Consolidated Machine Tool Corporation, General Motors Corporation, Rochester Products Division, Howard C. Clapp, Inc., Eastman Kodak Company, Kodak Park Works, Gleason Works, and Hickey Freeman Company.

Local Committees

The local arrangements for the Rochester Meeting were under the general supervision of Virgil M. Palmer, general chairman, Albert E. Schell, vice-chairman, and O. Lawrence Angevine, general secretary. Chairmen of the subcommittees were: Reception, James E. Gleason; Information and Registration, Albert E. Schell; Technical Events, Theodore F. Hooker; Plant Trips, Cleland C. Ross; Hotels, O. Lawrence Angevine, Printing and Signs, Arthur W. Schuster; Publicity, Wallace D. Wood; Entertainment, Lewis B. Swift; and Program for Women, Mrs. Karl H. Hubbard.

First Percy Nicholls Award Is Presented to E. G. Bailey

High Point of Joint A.S.M.E.-A.I.M.E. Fuels Meeting

REACHING a high point in the presentation of the Percy Nicholls Award to E. G. Bailey, vice-president, Babcock and Wilcox Co., at a dinner on the first evening of the two-day session in St. Louis on September 30–October 1, the sixth annual Joint Meeting of the Fuels Division of the Society with the Coal Division of the A.I.M.E. fully maintained the high standard of excellence of the former meetings.

The central theme of the four technical sessions at which ten papers were presented was that of adaptation of utilization of fuel to the demands of wartime conditions. Despite the pressure of increasing production for war and the diverting call of the simultaneous sessions of the St. Louis Cardinals and the New York Yankees in the World Series Games at Sportsman's Park, some 250 members and guests of the two societies registered and participated in the sessions.

The award presented to Mr. Bailey was established by joint action of the two Divisions during the past year to be granted annually, or as merited, for achievement in the field of solid fuels. It was named for the late Percy Nicholls to commemorate the outstanding contributions that he had made in the science and technology of fuels utilization. A committee of five, two from each Society who elect the fifth member, select the recipient.

E. G. BAILEY

In presenting Mr. Bailey to Eugene McAuliffe, president of the A.I.M.E., Julian E. Tobey, toastmaster, stated that the Committee had little difficulty in the choice of the recipient of the first award. He recounted Mr. Bailey's many achievements since graduation from Ohio State University in 1903, first as a chemist with Consolidation Coal Company, then with Arthur D. Little Co., Boston, with his own company, the Fuel Testing Co., the invention of the Bailey steam-flow air-flow boiler meter, the founding of the Bailey Meter Co., the invention of the Bailey waterwall, and his many accomplishments in the design of pulverizers and boilers with the Fuller-Lehigh Co. and the Babcock and Wilcox Co. Equally important to the inventions and contributions to the literature of fuels that Mr. Bailey has made, Mr. Tobey pointed out, are the training and inspiration that he has given hundreds of young men.

The citation on the beautifully engraved and framed scroll presented to Mr. Bailey read:

THE PERCY NICHOLLS AWARD

Awarded for Notable Scientific or Industrial Achievement in the Field of Solid Fuels

In recognition of the outstanding achievement of

ERVIN GEORGE BAILEY

in the field of solid fuels, the Fuels Division of the A.S.M.E. and the Coal Division of the A.I.M.E. confer upon him the Percy Nicholls Award for 1942.

His technical contributions to the art of preparing and utilizing the heat in solid fuel for the benefit of mankind are recognized and applied in all parts of the civilized world.

His inventive genius has always been tempered with practicability and has resulted in the maximum usefulness of the mechanism which he has devised.

In Him We Recognize
A Lifetime of Service
Four Decades of Accomplishment
An Inspiration for Those Who Follow Him

NEWELL G. ALFORD
Chairman, Coal Division
A.I.M.E.

A. R. MUMFORD
Chairman, Fuels Division
A.S.M.E.

In his address following receipt of the award, Mr. Bailey cited the appropriateness of St. Louis for this award as it was in St. Louis at the Louisiana Purchase Exposition in 1903 that the Fuels Testing Branch of the U. S. Geological Survey initiated the research on fuels that was the forerunner of the U. S. Bureau of Mines with which Mr. Nicholls had served for so many years. He paid tribute to Mr. Nicholls' classic investigations of underfeed combustion, his original research on the viscosity of slags, and his contributions to the theory of coal sampling.

Turning to the war and the responsibility of the fuel engineer, Mr. Bailey said that the production of war materials now necessary would have been impossible without the improvements in coal mining, preparation, and utilization of the past twenty-five years. He called attention to the heavy task before us in converting boiler and metallurgical plants to coal because of the transportation crisis in oil and inspired all to meet the challenge.

Production of Blast-Furnace Coke

Following a brief speech of welcome by M. M. Leighton, director, Illinois Geological Survey, and a response by A. R. Mumford, chairman, A.S.M.E. Fuels Division, the first technical session, with Martin A. Mayers and Frank H. Reed as cochairmen, devoted attention to the production of coke under wartime conditions. I. M. Roberts, LaClede Gas Light Co., in a paper, "Increasing the Percentage Production of Large-Sized Coke at Fast Coking Rates to Meet Wartime Demands," stated that a mixture of 60 per cent high-volatile and 36 per cent low-volatile coal with 4 per cent anthracite fines was giving them 50.5 per cent foundry coke in 19 hours' coking time as compared to 32 per cent obtained with a 55–45 per cent blend of high- and low-volatile coal coked for 21.5 hours. Walter T. Brown, Jones and Laughlin Steel Co., presented a comprehensive survey of the expanding properties of high- and low-volatile coals of West Virginia and Pennsylvania in his paper, "Plan to Improve Blast-Furnace Coke," and related these properties to the geology of the seams of coal. Uniformity of size was said by Brown to be the most important characteristics of blast-furnace coke.

New Data on Clinkering

The first paper of the second session under the cochairmenship of Carl T. Hayden and Ralph A. Sherman was that of Ray S. Weimer, Northern Illinois Coal Corporation, "A New Criterion for the Clinkering Characteristics of Coal Ash." Because of the author's illness, the paper was presented by Mr. Sherman. It presented a completely new concept of the measurement of the clinkering characteristics of coal ash by the apparent specific gravity of clinker formed in burning coal in an underfeed stoker of residential size. Several years of experience with the method had proved it a better guide for the selection of coals for various types of service and for the modification of clinker by the addition of silica or fire clay to the coal than the ash-fusion temperature or the chemical composition of the ash that are now in general use.

Although the paper had not been available previously in preprints, the discussion was spirited and had to be cut short because of lack of time. Much more will undoubtedly be heard of this new tool for the fuel technologist.

"Some Ways to Avoid High Stoker Maintenance and Inefficient Combustion" summarized the experience of the author, A. R. Mumford, Combustion Engineering Co., and other engineers that he quoted that will aid in the elimination of boiler outages and reduced production of war materials. Harmon C. Ray, Carter Coal Co., in his paper, "The Distribution of Coal Dust by Tank Car as Pulverized Fuel," told of the experience of his company in the collection of dust from the tipple and

its transportation for use as pulverized coal without further preparation by the user. Discussers foresaw greater application of this method of handling coal dust after the war.

Colloidal Fuel in Wartime

A. R. Mumford and Martin A. Mayers presided over the third session at which H. L. Crain of the Kansas City Power and Light Co. discussed his experience in combination coal and gas firing. War demands for gas are expected to reduce the amount available to the plant, but the experience has been so favorable that a greater use is anticipated by the author after the war. The excellent summary of the available information on colloidal fuel made by W. C. Schroeder of the Bureau of Mines in his paper, "The Use of Mixtures of Oil and Coal in Boiler Furnaces," brought out a long discussion. This disclosed two schools of thought. Manufacturers and users of equipment burning coal were predominantly of the opinion that the installation of stokers or pulverized-coal burners to replace oil where coal could be burned with reservation of the available oil for those that could only use oil, was to be preferred to the mixture. Oil producers, on the other hand, favored the use of colloidal fuel as an emergency measure. Complete information on the performance of colloidal fuel was admitted to be lacking.

General Fuel Problems in War

In a clear straightforward presentation of the difficulties to be expected with the use of fuel in coming months Ollison Craig, Riley Stoker Corporation, gave his paper, "Meeting Wartime Fuel Problems," at the final technical session where A. W. Thorson and J. E. Tobey were cochairmen. W. A. Carter, L. A. Shipman, T. A. Marsh, and others added valuable suggestions from their experience. D. L. McElroy, in peacetime, professor of mining engineering, West Virginia University, but now in charge of mine supplies in the War Production Board, brought to the session the latest information in his paper, "Priorities in Mine Supplies." Discussers paid high tribute to the skillful and sympathetic handling of the industry's supplies problem by Professor McElroy. In the closing paper, A. Lee Barrett, Pittsburgh Coal Co., described how his company had used its machine shops for subcontract work and to repair and salvage equipment that formerly would have been scrapped, thus adding to the war effort.

Secretary Ickes Addresses Banquet

Joining with the Regional Meeting of the A.I.M.E. which held sessions devoted to mining problems on October 1 and 2, the fuels men heard an informal address at luncheon on the 1st by Louis Ware, president, International Agricultural Corporation, who recounted some of his many interesting experiences in mining metals, nitrates, and coal.

At the banquet of the Regional Meeting, Harold L. Ickes, Secretary of the Interior, gave an address, "War on Waste," in which he decried the prodigality with which we have produced and used our waning supplies of petroleum. He said that victory may depend on the amount of oil we can produce and transport for ourselves and the other United Nations.

Technical Committees Meet

The fuels meeting was preceded on September 29th by meetings of Subcommittees on ignitibility, on plasticity and swelling, and on sampling of coal, of Committee D-5 on Coal and Coke of the A.S.T.M. Two sessions of the Model Smoke Law Committee of the A.S.M.E. were also held during the two-day meeting at which substantial progress on its assignment was made.

RALPH A. SHERMAN.[1]

[1] Supervisor, Fuels Division, Battelle Memorial Institute, Columbus, Ohio. Mem. A.S.M.E.

A.S.M.E. Calendar

of Coming Meetings

Nov. 30–Dec. 4, 1942
Annual Meeting
New York, N. Y.

June 14–16, 1942
Semi-Annual Meeting
Los Angeles, Calif.

(*For coming meetings of other organizations see page 34 of the advertising section of this issue*)

Actions of A.S.M.E. Executive Committee

At Meeting in Society Headquarters on September 16

THE Executive Committee of the Council of The American Society of Mechanical Engineers met on Thursday, September 16, at Society headquarters, New York, N. Y. There were present James W. Parker, chairman, Clarke F. Freeman, vice-chairman, G. E. Hulse and C. B. Peck, of the Committee; K. W. Jappe (Finance), J. N. Landis (Local Sections), G. B. Karelitz (Professional Divisions); W. D. Ennis, treasurer; C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary. After luncheon the Committee met with the following members of the Research Committee: W. Trinks, chairman, Herman Weisberg, J. F. Downie Smith, E. G. Bailey, and C. B. Le Page, assistant secretary.

The following actions are of general interest.

Revision of 1941–1942 Budget

Upon recommendation of the Finance Committee the appropriation for the Engineers' Council for Professional Development was increased by \$850, an additional \$3000 was appropriated to complete redecoration of the Society rooms, and \$300 was added to the Publications budget for MECHANICAL ENGINEERING.

Production Clinics

The Secretary reported that six production clinics had been held, with satisfactory results, at Dayton, Ohio, on May 5; Cincinnati, Ohio, on May 27; Newark, N. J., on May 29; Bridgeport, Conn., on June 6; Birmingham, Ala., on June 11; and Boston, Mass., on June 26. (A fairly complete story of the Newark War-Production Conference, with a résumé of the principal addresses, appeared in the July issue of MECHANICAL ENGINEERING, pages 569–572.) These clinics were financed by the A.S.M.E., S.A.E., and other engineering societies. The Secretary announced that the War Production Board had contributed money for the holding of 20 to 25 additional clinics and that the Society had entered into a contract with W.P.B. to conduct these clinics in co-operation with other engineering societies.

Magazines for Army and Navy Bases

It was reported that, in response to a suggestion of the Engineers' Council for Professional Development, MECHANICAL ENGINEERING was being sent regularly to some 52 Army and Navy Post libraries.

Rubber and Plastics Group Approved

Upon recommendation of the Committee on Professional Divisions the Rubber and Plastics Subdivision of the Process Industries Division was advanced to the status of the Rubber and Plastics Group.

Examinations in Mechanical Engineering

The Secretary reported that V. M. Palmer, chairman of the Committee on Registration, has asked for men to serve on a State Committee on Examinations to co-operate with the New York State Board of Engineering Examiners in preparing examinations in mechanical engineering. A.S.M.E. Local Sections in New York State have been requested to make the necessary appointments. A similar committee was set up in 1939.

Appointments

The following appointments were reported:

Committee on Meetings and Program, E. J. Nobles as junior adviser, to serve until December, 1943.

Committee on Local Sections, S. R. Beitler, as alternate for F. W. Marquis.

Sectional Committee on Standardization of Letter Symbols and Abbreviations for Engineering and Scientific Terms, R. E. Peterson.

American Co-ordinating Committee on Corrosion (Research), C. H. Fellows.

Joint Research Committee on Effect of Temperature on the Properties of Metals, John H. Romann.

Inter-American Development Commission, A. M. Greene, Jr., Warren H. McBryde, and C. M. Muchnic.

1942 Local Section Group Conferences: Group I, Clarke F. Freeman; Group II, E. B. Ricketts; Group III, J. W. Parker and P. B. Eaton; Group IV, S. B. Earle; Group V, J. H. Herron; Group VI, Linn Helander; Group VII, J. W. Parker, and Group VIII, W. R. Woolrich.

A.S.M.E. WAR PRODUCTION COMMITTEE POSES IN FRONT OF AN M-4 TANK AT ABERDEEN PROVING GROUND

(Left to right: Col. C. E. Davies, Brig. Gen. J. S. Hatcher, Col. W. A. Borden, Carl F. Dietz, F. T. Letchfield, Brig. Gen. G. M. Barnes, Sol Einstein, Maj. Gen. C. T. Harris, Jr., W. L. Batt, A. R. Stevenson, Jr., G. A. Stetson, W. C. Dickerman, Col. James L. Walsh (chairman), R. C. Muir, Milton Katz (WPB), C. B. LePage, T. H. Wickenden, K. H. Condit, D. S. Ellis, John Lord O'Brien (WPB), Col. W. B. Hardigg.)

A.S.M.E. War Production Committee Inspects Aberdeen Proving Ground

Many Officers of Ordnance Department Accompany Group

MEMBERS of the War Production Committee of The American Society of Mechanical Engineers, Col. James L. Walsh, chairman, were guests of the Ordnance Department at the Proving Ground, Aberdeen, Md., on Wednesday, October 7.

During the morning the various types of weapons, from the pistol to the 8-in. howitzer, were explained and fired, including one piece of captured German ordnance. Antiaircraft fire under remote control was demonstrated.

Tanks Are Demonstrated

A line-up of several tanks and other pieces of mechanized equipment was next visited and, following a description of each vehicle, a demonstration run was witnessed from an elevated vantage point, with some spectacular maneuvers which indicated the adaptability to various types of terrain and the stability of the firing platform under difficult conditions. An opportunity was afforded for members of the party to ride in the tanks.

Following luncheon the committee inspected some of the extensive training facilities where methods of instruction were explained, beginning with the elementary shop work given to enlisted men in the Ordnance Replacement Training Center and ending with an inspection of some of the facilities of The Ordnance School, including the reproduction department, where printed and illustrative material are prepared, the antiaircraft fire-control facilities and the fire-control building, the machine shops, small-arms section, aviation ordnance section, and one of the mess halls, kitchens, and barracks.

Courses—One Week to Three Months

The Ordnance School is the largest institution for training personnel in the Ordnance Department beyond the training normally given men in Replacement Training Centers. The courses of instruction vary in length from one week to three months. There are 59 different courses of instruction included in the curriculum. Students come from ordnance organizations stationed in all parts of the country and foreign service. There are three divisions of training. The largest of these is the Officer and Officer Candidate Division. The Enlisted Division directs the training of students in a wide variety of courses in which the trainee is taught the technique of ordnance supply and maintenance activities. The attendance in the Base Shop division of the school varies with the organizations assigned. The training is obtained by the practical application of theoretical knowledge in the actual repair of unserviceable ordnance matériel.

Accompanying the committee in its inspection of the Proving Ground and Training Center were numerous officers of the Ordnance Department, including Major General C. T. Harris, Jr., in command of the Aberdeen Proving Ground, Brigadier General J. S. Hatcher, in charge of the Military Training Division, Brigadier General G. M. Barnes, chief of the Technical Division, Colonel G. W. Outland, commandant of the Ordnance School, and Colonel C. E. Davies, Secretary, A.S.M.E. and chief of the Control Branch, Office of the Chief of Ordnance.

1943 A.S.M.E. Mechanical Catalog and Directory Out

Over 550 Pages of Information

THE thirty-second annual A.S.M.E. Mechanical Catalog and Directory, 1943 edition, published October 1 by The American Society of Mechanical Engineers, was distributed to A.S.M.E. members during October.

In its catalog section, manufacturers describe and illustrate their products that are of interest to mechanical engineers. This section is followed by a Directory which gives the user a practically complete and authoritative index to manufacturers of metals and alloys, power-plant equipment, power-transmission equipment, instruments, materials-handling apparatus, aircraft power plants and instruments, foundry and machine-shop equipment, heating, ventilating, and air-conditioning equipment, electric motors and controls, equipment for process industries, pumps, fans, compressors, and many other types of mechanical apparatus. A page-reference system in the Directory ties up with the catalog, providing descriptions of the desired machine or equipment.

According to the editors of the volume, it is the only book which covers the field of mechanical engineering so thoroughly.

A 16-page insert describing all A.S.M.E. publications, such as power test, boiler construction, and safety codes, American Standards, fluid meters, engineering biographies, bibliographies, research reports, and manuals, is included in this volume for the ready reference of A.S.M.E. members and other users.

Data on American Patent System Desired by National Patent Planning Commission

At a meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at the Hotel Sagamore, Rochester, N. Y., Oct. 11, in connection with the 1942 Fall Meeting of the Society, consideration was given to a letter addressed to President Parker in which A. A. Potter, dean of engineering, Purdue University and executive director of the National Patent Planning Commission, asked for statements concerning the American patent system to aid him in a study being undertaken by the Commission.

The Executive Committee decided that Dean Potter's request could be most quickly and effectively met by publishing his letter in Mechanical Engineering with a statement urging members who have information likely to be useful to his studies to send it directly to him at Purdue University, Lafayette, Indiana. Dean Potter's letter, which explains the purpose of his study and the information he wishes forwarded to him, follows. Members are requested to communicate directly with Dean Potter as quickly as possible.

Purdue University

Office of the Dean of Engineering
Lafayette, Indiana

September 30, 1942

Mr. James W. Parker, President,
The American Society of Mechanical Engineers

Dear Mr. Parker:

On Dec. 12, 1941, the President of the United States, by Executive Order No. 8977, established the National Patent Planning Commission authorized, in conjunction with the Department of Commerce, to conduct a comprehensive survey and study of the American patent system, and consider whether the system now provides the maximum service in stimulating the inventive genius of our people in evolving inventions and in furthering their prompt utilization for the public good; whether our patent system should perform a more active function in inventive development; whether there are obstructions in our existing system of patent laws and, if so, how they can be eliminated; to what extent the Government should go in stimulating inventive effort in normal times; and what methods and plans might be developed to promote inventions and discoveries which will increase commerce, provide employment, and fully utilize expanded defense industrial facilities during normal times.

The five members of the Commission are Charles F. Kettering (chairman), Owen D. Young, Edward F. McGrady, Chester C. Davis, and Francis P. Gaines. The executive secretary of the Commission is Commissioner Conway P. Coe of the United States Patent Office, and the executive director is A. A. Potter, dean of engineering at Purdue University.

You can aid me in my duties as executive director if you will ask members of The American Society of Mechanical Engineers to send me statements of any problems which may have been encountered by them in creating, developing, commercializing, or protecting new inventions. Have any of the present Patent Office practices or patent laws proven detrimental to our war effort or to the encouragement of inventiveness? What should be done to stimulate inventiveness in the interest of the war effort? Suggestions and data available to the A.S.M.E. which bear upon the studies which the Commission must undertake in order to carry out the President's Order will also be appreciated.

Cordially yours,
(*signed*) A. A. Potter,
Dean of Engineering and Executive Director,
National Patent Planning Commission

Sigma Xi Lecturers for 1943

Five leading American scientists have been named Sigma Xi national lecturers for 1943, Dr. George A. Baitsell, secretary of the Society of Sigma Xi, the national honor fraternity for the promotion of scientific research, has announced.

Chosen to address special meetings at universities and colleges throughout the nation, the eminent scientists selected will deliver their lectures during January, February, March, and April of next year and will discuss scientific subjects upon which they are authorities.

Each of the lecturers will deliver his topic in a series of institutions at dates and locales to be announced later. The Sigma Xi lectures are annual events in the dissemination of newest important advances in the selected fields of science.

The lecturers include:

Dr. G. D. Birkhoff, Perkins professor of mathematics, Harvard University, who will lecture on the "Mathematical Nature of Modern Physical Theories." He will endeavor to establish, in elementary terms, the fact that, since 1900, mathematical ideas have been responsible for theoretical advances of modern physical theories.

Dr. D. W. Bronk, professor of neurology, University of Pennsylvania, who will speak on the "Physical Structure and Biological Action of Nerve Cells." He will discuss this subject not only from the standpoint of research now in progress but also with attention to the biological consequences of the demands of modern warfare and aviation.

Dr. Peter Debye, professor of chemistry, Cornell University, whose topic is "The Magnetic Approach to Absolute Zero." He will tell what prevents science from reaching the absolute zero and discuss whether magnetic cooling can be applied to the nucleus of the atom.

Dr. C. A. Elvehjem, professor of agricultural chemistry, University of Wisconsin, who will discuss "The Present Status of the Vitamin B Complex." He will explain that the vitamin B complex consists of at least a dozen separate factors, each of which can be obtained in pure form. He will report recent work on the use of sulfaguanidine and the evidence for the synthesis of several B vitamins in the intestinal tract.

Dr. H. Mark, professor of chemistry, Brooklyn Polytechnic Institute. The title of his lecture is "Fundamental Aspects of the Elasticity of High Polymers." He will explain that the high polymers are chemical compounds that provide us with rubber, plastics, and fibers. Dr. Mark will discuss the structure of these complex chemicals which mean so much to our war effort.

1942 Officers of A.S.M.E. Elected by Letter Ballot

As reported by the tellers of election, Collins P. Bliss, Francis Hodgkinson, and S. D. Sprong, letter ballots received from members of The American Society of Mechanical Engineers were counted on Tuesday, Sept. 22, 1942. The total number of ballots cast was 4259 but of these 195 were thrown out as defective.

Candidates	*Votes for*	*Votes against*
President		
Harold V. Coes	4055	9
Vice-Presidents		
Thomas E. Purcell	4060	4
Joseph W. Eshelman	4049	15
Guy T. Shoemaker	4056	8
Walter J. Wohlenberg	4052	12
Managers		
Roscoe W. Morton	4058	6
Alexander R. Stevenson, Jr.	4060	4
Albert E. White	4060	4

In addition to the votes cast for the elected directors, valid ballots were cast as follows: For president, 7 names, one vote each; for vice-president, 6 names, one vote each; and for manager, 5 names, one vote each.

The new officers will be introduced and installed in office during the Sixty-Third Annual Meeting of the Society to be held in New York, N. Y., Nov. 30 to Dec. 4, 1942.

Biographical sketches of the newly elected officers appear in the August, 1942, issue of Mechanical Engineering, pages 634–637.

Copies of "Mechanism of Lubrication" Available

A number of copies of "The Mechanism of Lubrication," by William F. Parish and Leon Cammen, are available at $1.25 per copy from the Publication Sales Department, A.S.M.E., 29 West 39th St., New York, N. Y.

This 42-page photo-offset reprint contains two papers, "The Mechanism of Lubrication," presented at an informal Lubrication Conference, June 1, 1932, and "The Chemical Mechanism of Lubrication," presented at the 1932 A.S.M.E. Annual Meeting. Discussions of the paper, including comments by *Engineer* and *Engineering*, are also included.

Conservation in Electric Motor and Control Industry

THE Electric Motors and Control Section, General Industrial Equipment Branch, War Production Board, has issued a memorandum to those who specify, use, or produce electric motors and controls under the title, "Recommendations Leading to the Maximum Conservation and Economical Use of Critical Materials in the Electric Motor and Control Industry." The memorandum follows:

W.P.B. Recommendations

The material allotment to the electric motor and control industry has made it necessary for the Electric Motor and Control Section of the War Production Board to recommend and initiate a twofold program to conserve critical materials. This program consists of the utilization of full service factor of electrical equipment, and design simplification, along with extensive use of secondhand electric motors and control.

There is an ample supply of used or secondhand standard electric motors and controls available in dealers' hands and, particularly, in many manufacturing plants, according to information made available. Since approximately 90 per cent of this industry is tagged for the armed services and the most vital war plants, deliveries on all but the most vital orders are quite long and sometimes impossible. The use of secondhand motors would effect immediate delivery as well as the saving of critical materials. It will require considerable vigor, imagination, and ingenuity on the part of the user in order to locate and adapt secondhand equipment. If the operator cannot locate secondhand equipment by his own efforts, he may fill out, sign, and return a prepared form,[1] and the Electric Motor and Control Section will assist him in attempting to locate suitable equipment.

Electric-motor manufacturers have received no conclusive evidence of overloading motors on the part of operators. We have been advised that motors today do not break down because of overheating resulting from overloading, but rather because of mechanical failure.

Therefore, where new electric motors and control are required because of their special characteristics, we would suggest that all purchasing agents, engineers, architects, and consultants, who will be concerned with the operation, or design, or application of electric motors and control, follow out, to the best of their ability, the following recommendations:

Recommendations for Governing the Size of Electric Motors

1 In applying motors, determine with maximum possible accuracy the horsepower required. This should be preferably obtained by test or, in the event that this is impossible, by accurate calculation, or by careful comparison with known power requirements of similar apparatus.

2 When applying open-type, alternating-current, continuous-rated 40 C, motors where the motor rated voltage is maintained and where the ambient temperature is usually substantially below 40 C and will only occasionally or for short periods equal or slightly exceed 40 C, select the standard horsepower rating which is not substantially more than 80 per cent of the horsepower determined in accordance with recommendation 1.

Example: The required horsepower, ' as determined in paragraph 1, is 9.3 hp; 80 per cent of 9.3 equals 7.44, so select a standard 7.5-hp motor.

3 When applying a motor, alternating or direct current, rated on a 50 C or 55 C basis, where the motor rated voltage is maintained and where the ambient temperature is usually substantially below 40 C and will only occasionally or for short periods equal or slightly exceed 40 C, select the standard horsepower rating which is not substantially more than 91 per cent of the horsepower determined in accordance with recommendation 1.

4 After selecting a motor in accordance with recommendations 2 and 3, torque and operating speed should be checked to assure their tendency.

5 When applying an open-type continuous-rated 40 C, direct-current motor in a location where the ambient temperature is usually substantially below 40 C and will only occasionally or for short periods equal or slightly exceed 40 C, select the standard horsepower rating which is at least 87 per cent of the horsepower determined in accordance with recommendation 1.

Recommendations for Selection of Motor Types

The type of motor selected shall be of the simplest mechanical and electrical design which can be used to economically accomplish the purpose for which the motor is purchased. Where operating conditions permit, the following specifications should be adhered to:

1 Open-type motors rather than protected motors.

2 Motors of high speed instead of low speed.

3 Single-speed rather than multispeed motors.

4 Single winding rather than two-winding where multispeed motors are essential.

5 Alternating-current instead of direct-current motors where alternating power is available.

6 Squirrel-cage instead of slip-ring motors.

7 Single-voltage motors only should be specified.

8 Direct-current adjustable-speed motors should have a lesser speed range than formerly used.

Recommendations for the Selection of Industrial Motor Controllers

1 The wiring of all controllers should be specified as following the shortest possible route consistent with the avoidance of electrical and mechanical interferences. This will result in approximately 30 per cent reduction in the amount of copper wire used.

2 When controllers are built to order for a specified horsepower, busses, terminals, and wiring should not be specified in a size larger than the minimum required by the application for which the controller is designed.

3 No controllers should be specified of a capacity in excess of the minimum required for the application.

4 No equipment or device should be specified for a controller which can be eliminated without causing severe operating hazards. This equipment includes indicating lamps, special name plates, instruments, test receptacles and jacks, extra terminals, special locks, items for the improvement of appearance, etc. If specifications are cut to the minimum for successful operation, many tons of critical material will be saved.

5 Control-circuit wiring should not be specified in a size larger than the minimum required to carry the current and to insure reliable and safe operations.

6 Controllers should not be specified with finishes which contain critical materials unless these finishes are absolutely necessary to maintain operation of the controller.

7 Color coding of controller wiring should not be specified, unless absolutely necessary. Color-coding specifications force manufacturers to carry larger stocks of wire than would be necessary if one-color wire were used.

8 Control-circuit transformers should not be specified, unless the line voltage is higher than 600 volts, or unless suitable pilot devices of adequate voltage rating are not available.

9 Control-circuit fuses should not be specified if the control transformers have less than a 2200-volt primary winding or if the control circuit is direct current.

10 Where full voltage starters are available, and, if motor design will permit, reduced-voltage starters should not be specified, unless torque must be limited, or if system capacity makes full-voltage starting impossible.

11 If manual controllers of suitable ratings are available, magnetic controllers should not be used, except where pilot devices are essential to the operation controlled or where lack of undervoltage protection would result in definite danger to human life.

Recommendations for Electrical Layouts

1 For new plants or extensions the utilization voltage should be restricted to 440 volts, alternating current except where motors 100 hp and larger are used, in which case the voltage should be 2200 volts or more.

2 No auxiliary or reserve busses or their attendant equipment should be provided.

3 Network distribution systems should not be used unless they show an over-all saving in critical material.

4 No equipment of any kind should be installed to provide for future loads or extensions.

5 No duplicate feeds or loop feeds should be used if any appreciable amount of material is

[1] This form, not reproduced here, may be obtained by writing to the Electric Motors and Control Section, General Industrial Equipment Branch, War Production Board, Washington, D. C.

required above that necessary for a single radial feeder.

6 All busses and feeders should be tapered as to size where long runs are used with loads being taken off along the run.

7 Requirements should in all cases be based on demands after load factor is considered and all equipment specified so it will be loaded as near name-plate rating as possible.

Do not specify equipment of higher rating than load requirements in order to secure safety factor.

General

1 No electric motor and control should be purchased for any use unless reasonable effort has been made to obtain used or secondhand equipment, unless the maximum number of shifts are used, or unless reasonable effort has been made to adapt idle equipment in the possession of the user to the application.

2 No electric motor and control should be purchased for replacement of existing equipment for reasons of breakdown, damage, or obsolescence, unless reasonable effort is made to keep equipment in operating condition by installation of renewal parts or a reasonable amount of maintenance work.

3 No electric motor or control should be purchased in a size larger or of more complex design and construction than is required by the minimum operating conditions.

Annual Water Conference in Pittsburgh, Pa., Nov. 9–10

THE Third Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held at the William Penn Hotel, Pittsburgh, Pa., on November 9 and 10, according to an announcement by H. M. Olson, general chairman. The program will contain the following speakers and subjects:

F. N. SPELLER, consulting metallurgist, Pittsburgh, Pa., "Review of Recent Developments on Under Water Paints and Coatings."

DR. R. B. MEARS, research engineer, Aluminum Research Laboratories, New Kensington, Pa., "The Use of Chemical Inhibitors for Aluminum Equipment."

J. A. HOLMES, director of service, National Aluminate Corporation, Chicago, Ill., "The Use of Chlorophenols in Slime Control for Condensers and Cooling Equipment."

FREDERICK G. STRAUB, research professor, University of Illinois, Urbana, Ill., "Solubility of Salts in Steam at High Pressures."

S. E. TRAY, water-treatment engineer, Allis Chalmers Company, Milwaukee, Wis., "Some Thoughts on the Treatment of Water for Power Plant Equipment Other Than Boilers."

S. F. WHIRL, chief chemist, Duquesne Light Company, Pittsburgh, Pa., and T. E. PURCELL, general superintendent, Power Stations, Duquesne Light Company, Pittsburgh, Pa., "Protection Against Embrittlement by pH Phosphate Control."

A. E. GRIFFIN, assistant director, Technical Service Division, Wallace and Tiernan Company, Inc., Newark, N. J., "Bacterial Metabolism and Corrosion."

HARRY A. FABER, research chemist, The Chlorine Institute, New York, N. Y., "War-time Possibilities of Water-Supply Contamination."

S. B. APPLEBAUM, vice-president, Technical Director, The Permutit Company, New York, N. Y., "Use and Application of Spiractor in Cold Lime and Soda-Ash Water Softening."

W. A. DARBY, sales engineer, The Dorr Company, Inc., New York, N. Y., "The Use and Application of the Hydro-Treater."

F. K. LINDSAY, chief chemist, National Aluminate Corporation, Chicago, Ill., 'The Use and Application of Resinous Zeolite in the Water-Treatment and Other Fields."

A.M.A. to Hold Production Conference, Nov. 10–11

THE Production Conference of the American Management Association will be held at the Hotel New Yorker in New York City on November 10 and 11. Among the subjects slated for discussion at the various sessions are: Women in the factory, simplifying production paper work, combating absenteeism, the Negro in the factory, man power, job methods training, effective suggestions systems, and scheduling machines.

Some of these subjects will be handled by individual speakers, others by panels. L. C. Morrow, vice-president of A.M.A.'s Production Division is planning the sessions and will announce the speakers a little later.

Bibliography Published on Electrical Safety

THE third bibliography of technical literature entitled "Bibliography on Electrical Safety, 1930–1941" has just been published by the American Institute of Electrical Engineers. This publication, sponsored by the A.I.E.E. committee on safety, is designed to make available a fund of information on electrical safety which should be of special interest at a time when accident prevention is of national importance. A list of applicable standards, specifications, and safety codes is also included. Information on safety published before 1930 may be located through bibliographies accompanying articles listed.

The items in this bibliography are divided into sections according to subject matter as follows:

A Electrical Accidents and Their Causes
B Accident-Prevention Methods
C Safety Codes and Standards
D Effects of Electric Shock
E Resuscitation.

"The Bibliography on Electrical Safety, 1930–1941" is a 16-page pamphlet, $8^1/_2 \times 11$ inches. It may be obtained from A.I.E.E. headquarters, 33 West 39th Street, New York, N. Y., at 25 cents per copy to Institute members, 50 cents to nonmembers.

A.S.M.E. Members Get Welding Awards

AMONG the 458 recipients of awards totaling $200,000 by the James F. Lincoln Arc Welding Foundation in its industrial-progress award program were several members of The American Society of Mechanical Engineers. The awards were made for papers submitted by engineers, designers, architects, maintenance men, and executives in the industrial field, which were judged by a 16-man jury of award headed by E. E. Dreese, chairman of the Foundation.

The first award, amounting to $13,700, was made to Capt. C. A. Trexel (CEC) U.S.N., and A. Amerikian, director of planning of design and designing engineer, respectively, Bureau of Yards and Docks, Navy Department, Washington, D. C. John L. Miller, chief metallurgist, Gun Mount Division, The Firestone Tire and Rubber Company, Akron, Ohio, won the second award of $11,200, and H. Thomasson, welding engineer, Canadian Westinghouse Company, Limited, Hamilton, Ontario, Canada, the third, $8700.

A.S.M.E. members who won awards were:

P. J. BIER, senior engineer, Bureau of Reclamation, Denver, Colo.

GEORGE W. MEEK, conservation consultant, Syracuse, N. Y.

E. W. ALLARDT, mechanical engineer, Babcock and Wilcox Tube Company, Beaver Falls, Pa.

COURT KINNISON, industrial engineer, Metal Products Fabricating Company, San Francisco, Calif.

C. DONALD FISHER, designer and draftsman, Sprout, Waldron and Company, Muncy, Pa.

E. W. JACOBSON, design engineer, Gulf Research and Development Company, Pittsburgh, Pa.

HENRY F. GAUSS, head of department of mechanical engineering, University of Idaho, Moscow, Idaho.

H. A. PIETSCH (in collaboration with R. M. RUSH), chief engineer, Heater Section, Industrial Department Machinery Division, Dravo Corporation, Pittsburgh, Pa.

S. BIRKLAND, assistant chief draftsman, American Can Company, San Francisco, Calif.

ELLIOTT F. WRIGHT, engineer in reciprocating pump engineering division, Worthington Pump and Machinery Corporation, Harrison, N. J.

ROBERT N. TUCKER, superintendent, Division of Electricity, Columbus, Ohio

J. F. STROTT, chief engineer, Link Belt Company, Pacific Division, San Francisco, Calif.

WILLIAM A. F. MILLINGER, professional engineer, Engineering Project Services, Los Angeles, Calif.

ROBERT E. MOYER, JR., vice-president in charge of engineering, Heilman Boiler Works, Allentown, Pa.

WILLIAM A. MCGEE, mechanical engineer, The New York Central Railroad Company, Cleveland, Ohio

GEORGE E. KENTIS, JR., chief engineer, The Yoder Company, Cleveland, Ohio

BURLING D. WELLS, plant engineer, Mallory Hat Company, Danbury, Conn.

CARL SCHNEIDER, consulting engineer, City of New Orleans, Department of Public Property, Division of Public Works, New Orleans, La.

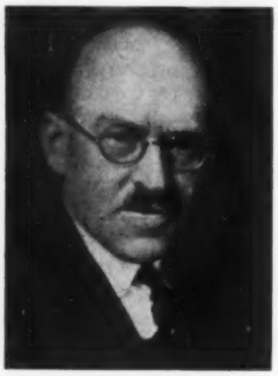
WILLIAM H. THOMPSON, chief engineer, Davis Engineering Corporation, Elizabeth, N. J.

Flanders Appointed to the Economic Stabilization Board

THE announcement recently appeared in the press of the appointment by President Roosevelt of Ralph E. Flanders, president of the Jones and Lamson Machine Company and past-president A.S.M.E., to the Economic Stabilization Board, which will advise James F. Byrnes, Economic Stabilization Director, in the discharge of his duties. Mr. Flanders is one of the two representatives of management, the other being Eric A. Johnston, of Spokane, president U. S. Chamber of Commerce.

The representatives of labor on the board are William Green, president of the American Federation of Labor, Philip Murray, president of the Congress of Industrial Organizations, Edward A. O'Neal, president of the American Farm Bureau Federation, and James G. Patton, president of the National Farmers Union.

The appointment of Mr. Flanders will be applauded by engineers throughout the nation. In the early days of the depression Mr. Flanders began writing and speaking on economic subjects and won national attention by groups of engineers, economists, and sociologists by the vigor, intelligence, and sanity of his views. He served as a member of the American Engineering Council's Committee on the Relation of Consumption, Production, and Distribution, whose reports were published in MECHANICAL ENGINEERING where other addresses by him on economic and sociological subjects have frequently appeared. He was a member of the Business Advisory and Planning Council of the United States Department of Commerce, the Industrial Advisory Board of N.R.A., and the Advisory Board for the Subsistence Homestead Administration. He served also as administrator of Machine Tool Priorities, O.P.M., as director of the Social Science Research Council, and as president of the New England Council. These assignments in social and economic fields have been in addition to his engineering services on national committees and international commissions, in the design of machine tools, as officer of engineering societies and trade associations, and as executive head of industrial enterprises.



R. E. FLANDERS

W. L. Batt and C. R. Dooley to Advise Government on Apprenticeship

TWO members of the engineering profession, one mechanical and the other electrical, have been named by Administrator Paul V. McNutt as management representatives on the Federal Committee on Apprenticeship which will advise the Federal Security Agency and the War Manpower Commission on apprentice training and related on-the-job training policies.

The two engineers are William L. Batt, past-president A.S.M.E., president of the S.K.F. Industries of Philadelphia, and Channing R. Dooley, manager of industrial relations, Socony-Vacuum Oil Company of New York.

Until the Apprentice-Training Service was transferred from the U. S. Department of Labor to the Federal Security Agency by the Executive Order of last April 18, combining all governmental labor training and supply agencies under one head to expedite the war effort, Mr. Batt and Mr. Dooley served as management apprenticeship advisers to the Secretary of Labor.

Other members of the Federal Committee are John P. Frey, president of the Metal Trades, Department of the American Federation of Labor; Clinton S. Golden, assistant to the president, United Steelworkers of America, an affiliate of the CIO; Mrs. Clara M. Beyer, assistant director of the Division of Labor Standards, U. S. Department of Labor, Layton S. Hawkins, chief, Trade and Industrial Service, Office of Education, and William F. Patterson, chief, Apprentice-Training Service, Federal Security Agency.

John Fritz Medal for 1943 to Willis Rodney Whitney

THE 1943 John Fritz Medal Board of Award has awarded its gold medal to Willis Rodney Whitney for distinguished research, both as an individual investigator and as an outstanding and inspiring administrator of pioneering enterprise, co-ordinating pure science with the service of society through industry. The Committee on Presentation will announce its plans at an early date.

Gerard Swope Elected Sixth Hoover Medalist

THE Hoover Medal Board of Award has announced the election of Gerard Swope, president of the General Electric Company, as the sixth recipient of the Hoover Medal. This Medal for distinguished public service was established in 1930 at the time of the Fiftieth Anniversary ceremonies of The American Society of Mechanical Engineers and was first awarded to Herbert Hoover for civic and humanitarian achievements. The trust fund creating the award was the gift of Conrad N. Lauer, past-president A.S.M.E., and is administered by a Board of Award from the four national societies—civil, mining, electrical, and mechanical. Presentation ceremonies will be announced shortly.

Among the Local Sections

Central Illinois Section Has Synthetic-Rubber Forum

MORE than 100 members and guests of Central Illinois Section took part in a forum held on Sept. 17 under the leadership of Dr. Ralph H. Manley. The various types of material available for the manufacture of synthetic rubber were discussed.

More Than 500 Turned Away at Chicago Joint Meeting

The Chicago Section of the A.S.M.E. in conjunction with other engineering groups held a meeting on Sept. 22 in the Engineering Building Auditorium which was filled to capacity by more than 900 engineers. Latecomers, numbering more than 500, were turned away. The urgent need in the U. S. Army and the U. S. Navy for engineers and men with special talents was explained by Dr. J. R. van Pelt and Lieut. Commdr. Thomas White. Also described was the organization and functions of the Army Specialist Corps. Official motion pictures of the Coral Sea and Midway Island battles and the bombing of the Marshall Islands were shown.

More than 300 members and guests of Chicago Section were present at the Oct. 1 smoker held at the Medinah Club. Included in the program were a social hour in the grill room, a buffet dinner with some novel entertainment features, and a talk on how American engineering is helping China to solve the manufacturing problems of war by Dr. Chang Lok Chen, Chinese consular general at Chicago.

Air-Raid Defense Discussed at Central Indiana Section

A lecture on plant protection and air-raid defense in Great Britain was given by P. W. Lambell, member of the British Purchasing Commission, before the members of Central Indiana Section at the meeting of Sept. 18. An interesting point brought out was that many of London's new underground shelters will eventually form part of the city's subway system.

Quartet of Experts Discuss Conservation at Cleveland

On Oct. 8, members of Cleveland Section listened to a quartet of experts discuss "Conservation and Substitution of Materials." Lieut. Howard Wolf, officer in charge of production engineering for the Cleveland Ordnance District, was the keynote speaker. He was followed by Morris L. Rask, Aluminum Co. of America, whose topic was "Aluminum." Next in line was F. E. Harrell, Reliance Electric and Engineering Co., who talked on "Copper." The final speaker was Howard Stagg, field engineer of the Crucible Steel Co., who covered the subject of "High-Speed Cutting Tools." A discussion period followed.

Colorado Section Plans Its Program for Coming Year

The chairman of the Colorado Section, Durbin Van Law, called a meeting of the executive committee at his home on Aug. 18 to discuss program plans for the coming year. Meetings planned included: Sept., smoker; Oct., military subject; Nov., transportation; Jan., mining; Feb., synthetic rubber; Mar., steam boilers; Apr., manufacturing in Denver; and May, reclamation service or aviation gasoline.

Colonel Walsh Talks on Science of Survival at Kansas City

Using as his subject, "Science of Survival," Colonel James L. Walsh, chairman of the A.S.M.E. Committee on National Defense, showed more than 100 members and guests of Kansas City Section on Sept. 24 why engineering is so vital in today's world conflict.

Metropolitan Section Hears Music Is an Aid to War Production

The use of music in war plants has become of increasing importance, stated Prof. Harold Burris-Meyer, Stevens Institute of Technology, in a talk given before the Metropolitan Section on Oct. 15. He showed how observations made in plants indicate that the use of music relieves fatigue and boredom. Employee morale is improved, accident rates are lowered, and production is increased.

Oxyacetylene Welding and Its Applications Described at Milwaukee

Oxyacetylene's many uses were described to more than 60 members and guests of Milwaukee Section on Sept. 9 by W. B. Browning. Use of oxyacetylene flame on steel billets in cutting, descaling, notching, and cleaning was discussed. Particular reference was made to processing of ship plate by flame machining, hardening, softening, and removal of moisture prior to painting. Strengthening of structural forms by heat applications and plate-contour cutting were touched on.

Time a Material Element if War Is to Be Won, Nebraska Hears

Speaking before the Nebraska Section on Sept. 23, Colonel James L. Walsh, chairman of the A.S.M.E. Committee on National Defense, said, "In this war it is nip and tuck whether we or our enemies will be the victors." He advised everyone to think of ways to conserve time, materials, and human life in order that our armies in the field will have the supplies necessary to win the war. Also discussed was the importance of logistics in the present war.

Navy Needs Engineers for Sea and Land Duty, Told to New Orleans

The U. S. Navy is greatly in need of men with engineering experience and training, Commander E. D. Walbridge, director of the New Orleans office of officer procurement, told members of the New Orleans Section at a dinner-meeting held on Sept. 25. Primary demand is for young engineers who can be trained to go to sea as engineering officers in various capacities. There is also need for older and more experienced engineers, principally civil engineers, to assist with construction of navy yards and bases in this country and abroad. Electrical engineers for radio construction and maintenance are likewise in demand, he said.

Wind Turbine Described to Members of Western Mass.

At its regular monthly meeting on Sept. 14, held jointly with the local chapter of the A.I.E.E., Western Massachusetts Section presented as speakers Dr. John B. Wilbur, chief engineer, S. Morgan Smith Co., and Harold Brown, chief engineer, Central Vermont Public Service, who talked on "The Smith-Turbine Wind Turbine," which is located on Grandpa's Knob, Caselton, Vt. The turbine, representing an investment of over $500,000, consists of a steel tower, 125 ft high, with a two-blade metal propeller having a diameter swing of 175 ft, directly connected to a pintal shaft, to which in turn is connected, on the upwind end, the mechanism, including a 1000-kw, 2300-v, 60-cycle, a-c generator.

Worcester Section Opens Its Year With October Meeting

Worcester Section held its first meeting of the 1942–1943 year on Oct. 6. Carl F. Scott, General Electric Co., gave an interesting talk on the search for substitutes for metals and our statistical position in the metals field.

With the Student Branches

A.S.M.E. Awards Certificates of Honor to Student Members

At its meeting in December, 1941, the A.S.M.E. Committee on Relations With Colleges approved a recommendation made at the Honorary Chairmen's Conference, with the result that the Society now provides for each Student Branch a certificate to be awarded to the student-member in good standing, recommended by the Honorary Chairman, who has contributed the most to the development of his Branch during the year. The certificate is signed by the President and Secretary of the Society and bears the name and college of the recipient and year of service.

A list of the recipients of the certificate, a facsimile of which accompanies this article, together with the name of the school making the award, follows:

University of Akron, Fred Brown
University of Alabama, C. Clyde Porter
University of Arizona, Eugene Nelms
University of Arkansas, B. B. DeLamar
Brown University, Roy Roberts
Bucknell University, Robert W. Donehower
California Institute of Technology, Lawrence W. Smith
Colorado School of Mines, Robert F. Hartman
Cooper Union Institute of Technology, Murray Sackson
University of Delaware, Alvin H. Green
University of Detroit, Edward J. Nesbitt
Drexel Institute of Technology, John Schuster, Jr.
Duke University, F. Kent Boutwell
University of Florida, Joseph H. Singer
George Washington University, Robert McCullough
Illinois Inst. of Technology, Herbert N. Hansen
Kansas State College, Arthur McGovern
University of Kentucky, T. C. Jackson
Lafayette College, Jack R. Dunn
Lehigh University, John H. Dudley
Louisiana State University, Ben F. Hair
University of Louisville, David P. Newbern
University of Maine, Harold J. Jordan
Marquette University, Robert K. Langdon
Michigan College of Mining and Technology, Robert F. L. Petaja
Michigan State College, Ray C. Edwards
University of Minnesota, James Mitchell
University of Missouri, Harold W. Hilker

(*Continued on page 824*)


The American Society of Mechanical Engineers

Awards this Certificate to

in recognition of his outstanding efforts and accomplishments in behalf of the A.S.M.E. Student Branch at

during the 1941-42 school year

James W. Parker
President

C. E. Davies
Secretary

FACSIMILE OF A.S.M.E. STUDENT BRANCH CERTIFICATE
(Original is 9×12 inches.)

(*Continued from page 823*)
University of New Mexico, Albert D. Ford, Jr.
N. Y. University Evening School, Raymond J. Seitz
North Carolina State College, James B. Sibert
North Dakota State, Robert L. Perkins
Northeastern University, Robert H. Murray
Northwestern University, Leonard V. Sloma
Ohio Northern University, Herbert M. Park
Ohio State, Paul Recknagel
Oklahoma Agricultural and Mechanical College, Norman W. Kirschke
Oregon State College, Fred Young
University of Pennsylvania, Albert J. Magee
Pratt Institute, John C. Washington
Princeton University, William L. Hutton, '43
University of Puerto Rico, Esteban Terrats-Acha
Purdue University, D. A. Tilley
Rensselaer Polytechnic Institute, Franklyn Gokey
Rice Institute, L. L. Blake
Rose Polytechnic Institute, Alan W. Ker
Rutgers University, Leonard M. Zubko
Southern Methodist University, Marvin V. McDonald
Stevens Institute of Technology, Robert S. Seybolt
Swarthmore College, Lindsay H. Wolfe
University of Texas, George Yelderman
Tufts College, Leonard C. Dozier
Vanderbilt University, John Hutton
University of Vermont, William L. Potter
Virginia Polytechnic Institute, John E. Ginter
University of Washington, Gordon P. Sadick
West Virginia University, Howard E. Holtzworth

Branch Meetings

Akron Holds Summer Meetings

JUST as many other schools throughout the land, the University of Akron kept its engineering school during the summer in order to accelerate the training of engineers. AKRON BRANCH held meetings at which the members were given an opportunity to participate.

CASE BRANCH reports that recent and forthcoming activities of the group include a stag picnic on Sept. 23; an A.S.M.E. sponsored movie entitled "Steel—Man's Servant," as shown on Oct. 7; and a hay ride on Oct. 24.

COOPER UNION BRANCH members viewed on Sept. 14 a motion picture, entitled "Arteries of Industry," which described graphically the production of steel pipe, from the iron ore to the finished product.

Steam Turbines at Washington

An illustrated lecture on modern steam turbines was given by J. R. Carlson, application engineer of the Westinghouse Elec. & Mfg. Co., before the members of the GEORGE WASHINGTON BRANCH on Sept. 2. The property of certain metals with relation to creep and relaxation was explained and its relation to the development of high-temperature and high-pressure turbines was stressed.

MARYLAND BRANCH held two meetings during August. The speaker at the first meeting on Aug. 5 was Dean S. S. Steinberg, who took as his topic, "The Professional Engineer." In his talk, he stressed the importance of social subjects in the training of an engineer. The second meeting was held on Aug. 21 at the Greenbelt, Md., swimming pool and picnic grounds and stressed the subject of relaxation from studies. With more than 50 students present, as well as most of the faculty, the affair proved very successful and will be incorporated into next year's summer program.

MISSOURI MINES BRANCH presented at its Sept. 18 session a sound motion picture, entitled "Production Lines of Defense." It showed the design and construction of the new Chrysler tank plant. Following the film, plans for a fall outing were discussed. The suggestion was also made to conduct an essay contest in which all members would be eligible to present their technical papers in competition for a worth-while prize.

MISSISSIPPI STATE BRANCH held a meeting on Sept. 2 at which T. R. Jones described his hobby, which is photography. He spoke of the advantages and disadvantages of different cameras and methods. This meeting closed the summer session.

94 Present at Pratt's First Meeting

At the first meeting of the current season held on Sept. 3, PRATT BRANCH was host to 94 members and guests. The showing of the film, "Empires of Steel," depicting the construction of the Empire State Building, was acclaimed by all present. The publicity and membership committee as well as the program committee members were appointed.

PURDUE BRANCH'S get-acquainted meeting was held on Sept. 22 and attracted an audience of more than 225. The meeting was opened by Chairman S. R. Lloyd, who spoke briefly on the organization and its program for the coming year. Prof. H. L. Solberg, head of the mechanical and aeronautical engineering department, gave an interesting outline of national A.S.M.E. affairs and discussed the value of membership in a technical society. The meeting was concluded with the showing of the motion picture, "With Williamson Beneath the Sea," and the serving of refreshments.

ROSE POLY BRANCH members met on Sept. 22 to listen to a paper on "Lubrication of High-Speed Bearings," presented by Charles Thomas. He explained the difficulties encountered when using ordinary means of lubrication at high speeds. It was a subject which was both interesting as well as instructive.

Friendly Spirit at Santa Clara

In order to get each member acquainted with all the others, Chairman Paul Steffan of the SANTA CLARA BRANCH at the first meeting on Sept. 16 had each member get up and give his name, home town, and year in the school. Philip Stephens then gave a paper which described his experiences during the summer while working in a shipyard. Many of the accidents which occurred during his stay could have been avoided with a little care on the part of the workmen and a little more supervision by the management, he stated.

TEXAS A.&M. BRANCH, it was reported at the July 20 session, has been experimenting in getting the seniors to assist the underclassmen at a series of "help" sessions. From results achieved, the experiment has proved to be so successful that plans are now being made to make this work a regular activity of the Branch. The advantages and disadvantages of steam and electric locomotives was shown in a film, entitled "Railroads."

VIRGINIA BRANCH officers met on Sept. 26 to discuss plans for the coming year. Suggestions included the showing of movies, the presenta-

tion of 15-minute papers by student members, and inspection trips.

119 at First V.P.I. Session

The first session of the year held by V.P.I. BRANCH on Sept. 28 attracted 105 members and 14 guests. E. M. Simons, honorary chairman, and R. O. Swain, chairman, gave short talks welcoming the members to the A.S.M.E. and its meetings. Since C. R. Ham, secretary, had resigned and joined the Army Air Corps, E. R. Fryer was elected to fill the vacancy.

WASHINGTON BRANCH featured a talk by Chairman Robert Bown at the Sept. 4 session. He emphasized the advantages of membership in the A.S.M.E. and stated that such membership is valueless unless the member attends meetings and presents technical papers. Arrangements were made at the Sept. 9 meeting for the joint meeting of the Branch and the student chapter of the A.I.M.E. at St. Louis, Mo., Sept. 28 to 30, 1942.

YALE BRANCH meets once a week, usually on Tuesday morning, at which time ten-minute talks are given by members. In this way, each member has an opportunity to deliver a paper. After each talk, the floor is open for discussion of the paper and criticism of the speaker's delivery. This procedure has proved to be very successful in past years in aiding the students in the art of public speaking.

The Engineer and Citizenship During The Present Emergency[1]

BY WELDON F. STUMP

THE American people are today making their greatest military effort. They are finding themselves offguard in the midst of an armed world. They have grown stagnant thinking of social securities, unemployment insurances, W.P.A., and the like, while the rest of the world has been arming to the teeth. But now the tide has turned, and instead of enjoying a way of life heretofore thought to be impregnable, they are forced into a war to protect their way of life.

The problem now becomes one of preparing to encounter an armed enemy, surpassing him, and defeating him. To do this the American people must revise their entire economic organization and produce inconceivable quantities of war supplies. In this program the engineer becomes the focal point. He assumes the position of co-ordinator in the conversion of peacetime enterprises to industries producing tanks, guns, airplanes, merchant ships, and naval vessels. He furnishes the technical information necessary in the research, design, development, and production of new implements of war and becomes a technical adviser to the Government whose problems are largely technological in nature. Technical branches of the armed forces are being organized and manned by engineers.

This Is an Engineer's War

In reality, this war has become an engineer's war, because it can only be won by the side which develops the most effective implements of destruction. In this respect, the engineer is today's most important citizen, for with him rests the responsibility of providing means of winning a victory which will preserve a way of life that has become so dear.

But why is it that, after having done a fine job in planning, designing, and building the marvelous mechanical world of today, the engineer is forced to turn about-face and create implements of destruction to protect his life and his ideals? Possibly one of the reasons may be that the engineer has neglected a thing called citizenship.

Engineers Have Neglected Social Problems

Many engineers in the past have taken their slide rules and their research probelms and have worked in seclusion while the rest of the world whirled by. Having solved their problems and developed new products or processes, they stopped and allowed some enterprising capitalist or political statesman to take over. As a result, we have a wonderful material world in the midst of social disorganization.

The best evidence that this condition existed in the United States of America, where we have the finest of everything—automobiles, household appliances, recreational facilities, educational opportunities, etc.—is that before the war, we still had 10,000,000 unemployed, a huge national debt, and many of our people in a state of discouragement with but little hope for the future.

While the American free-enterprise system has been the driving force of most of our advancements and developments, it has also been the source of much discontent and suffering. In many instances, the thought in mind was man for production, not production for man. As a result, the fruits of toil of many of our people have gone to build colossal fortunes for some few, thus leaving only a humble existence for those caught in the maelstrom of circumstance.

There is no doubt that the average American standard of living is the highest that has ever existed. Nevertheless, for the last ten years, we have been striving to hold on to what existed instead of building ahead. We have resorted to all sorts of recovery experiments, such as pump priming, production restriction, price control, etc., all of which were directly opposed to our previous free-enterprise teachings. Things have gone so badly since 1929 that we now have a doubtful, pessimistic group of people who wonder what kind of a social order or disorder this is that produces jobs to build guns and tanks for war but leaves them jobless in times of peace. Certainly they cannot help but think that

Cushing, N. Y.

A SUNSET SKY-LINE SILHOUETTE OF NEW YORK CITY FROM BROOKLYN BRIDGE

(See pages 831–842 for A.S.M.E. 1942 Annual Meeting events.)

[1] This essay, written by Weldon F. Stump, Purdue University, class of May, 1942, in mechanical engineering, received the A. A. Potter Award from the A.S.M.E. Committee on Engineers' Civic Responsibilities, of which A. R. Cullimore, president of the Newark College of Engineering, is chairman. A report concerning the activities of this Committee appeared in MECHANICAL ENGINEERING, Feb., 1942, p. 161.

something is amiss, that capitalism has failed, and that maybe they need a form of state socialism through the medium of which the Government will operate their farms, their factories, and their stores to produce, build, and distribute the so-called modern necessities of life to all of the people.

Any form of state socialism, however, would eventually lead toward stagnation and probably militaristic control. Individual initiative would die, and the competitive spirit would be dampened, resulting in competition for tangible wealth instead of building with farsighted ideals.

Engineers Must Preserve Free-Enterprise System

With this in mind, the only alternative is the continuation of the capitalistic enterprise system. The preservation of the free-enterprise system, however, places on the engineer one of his greatest responsibilities—that of selling to the American people the idea that this war is to be fought to save our way of life, our way of Government, and our way of economic intercourse. To lose these things would be to lose this war, regardless of the outcome of the military operations. The engineer must see that no such defeat comes to the American way of life.

To do this job, the engineer must develop a deeper sense of social responsibility. He must become a citizen equal to his capacity. Not only must he take part in general civic matters, vote regularly, and pay his taxes, he must become a leading citizen of his community. He must be outstanding in his contributions to the armament programs, to the home-defense programs, or to any other allied war activities. The home-defense programs, that are being organized throughout the country, offer excellent opportunities for the engineer to become acquainted with civil organizations and to impress upon their members the importance of engineering, by personally contributing badly needed technical advice.

The older members of the engineering profession are realizing the importance of assuming social responsibility through citizenship. This is exemplified by The American Society of Mechanical Engineers, which has established a Committee on Engineers' Civic Responsibilities to create interest among engineers on such matters.

Responsibilities of the Educator

With this as a start, the job of follow-up falls squarely on the shoulders of the young American engineer. The basic conception of the job to be done must be instilled in the young engineer by educators who have a clear perspective of the profession's social responsibility. Not only must the student engineer be taught the fundamentals of mathematics, physics, and mechanics, but he must be given a progressive education which teaches him a philosophy of life and enables him to analyze and co-ordinate its social, economic, and political aspects, along with the mechanical.

Educators must realize that from its youth a country grows. The dictators of the day have recognized this fact and have used youth as a medium through which to introduce and build their social brainstorms. If the education of the youth is narrowed to controlled channels, they become puppets instead of citizens and follow their leaders into selfish aggression and destruction. Thus, we see the importance of training the engineering youth to think clearly, analyze impartially, and decide fairly in all matters involving his fellow men.

How is the young engineer best to further his aims in citizenship? His first job is selling himself—selling himself to his employer, to his fellow workers, and to his community. The young engineer must develop a character that will bring advancement for himself and create prestige for his profession. A flawless character is essential in professional success. In selling himself to his community, he must represent the ultimate of citizenship. By becoming an active participant in community affairs, the engineer will become acquainted with people in all walks of life and will learn their habits, their hopes, and their prejudices. If the engineer ever aspires to play any part in the social control of mankind, he must acquaint himself with mankind, in order to obtain an understanding of the human aspects of situations with which he will be confronted.

Keeping Abreast of the Times

The young engineer must keep informed regarding city, state, and national issues; become affiliated with national engineering organizations; give co-operation and support to governmental and public-service undertakings that appear sound; provide constructive criticism of unsound projects promoted by self-interest groups; and finally, help the less educated groups to be good citizens. Keeping informed in regard to the daily issues of the world means keeping abreast of the times. A knowledge of all issues is essential in making a thorough analysis of conditions, formulating sound opinions, and helping to plan progressive projects. By following the trends of the day, the engineer will be in a position to know when and how it is best to stimulate his fellow citizens to obtain co-operation on progressive social measures.

Engineering Societies Promote Social Progress

Affiliation with engineering clubs and societies is a means of giving support to one of the most effective methods of achieving social progress. Engineering organizations are conducted by men who have a constructive philosophy of life, men who are sincerely interested in furthering, not only their own professions, but also the interests of mankind. Such organizations furnish the pressure necessary to eliminate the graft and unfairness which have been prevalent in many of the dealings with social problems. Such organizations, collectively, can offer technical assistance to our Government which certainly needs such assistance in the technical world of today. These organizations, to be effective, however, require the thoughtful support and action of each and every individual in the engineering profession.

Engineering Instructors for War Workers

One of the biggest jobs of the engineer is to educate and guide the working groups. During the emergency, engineers must train millions of men for new tasks. Institutions of engineering education are co-operating with the defense effort by speeding up their educational programs to help meet the ever-growing demand for technically trained men. These institutions are supplementing their regular curricula with night courses and short day courses to provide educational facilities for those endeavoring to prepare themselves for defense jobs requiring specialized training. Many colleges and universities throughout the country are helping the Army and Navy to train their personnel.

These efforts will result in a higher level of education for all of the people of the United States. The activities of the engineering pro-

A.S.M.E. STUDENT BRANCH OFFICERS AT IOWA STATE COLLEGE REMOVING TIRES FROM DEMONSTRATION CAR IN MECHANICAL-ENGINEERING LABORATORY

(Left to Right: Phil Goddard, president; John Doolittle, vice-president; Prof. Lynn T. Brown; John H. Baker, secretary.)

fession in such educational programs should create confidence in the people for engineering as a whole. It will demonstrate what engineering can do for them.

Postwar Adjustments

After the war, however, engineering education and leadership cannot be allowed to lapse, for then will come the big test. Millions of trained men and women will be wanting peacetime jobs on which they can best use abilities that they have developed. The engineer must assume the responsibility of guiding these people back to a progressive industrial life. To do this, the people must be made to understand their social problems and taught how to adjust themselves to new social and mechanical innovations. They must be made understanding citizens, not working masses of labor. Probably one of our greatest sources of social ills in the past has been the inability of the people to adjust themselves to the effects of industrial innovations. People must be taught to expect them as natural steps of progress and, until transition adjustment is completed, further progress cannot take place.

"Honest Citizenship"

The discussion thus far has dealt with the generalities of civil and social responsibilities of the engineering profession during the emergency and for the following peace. But before we can ever hope to have success in these fields, we must base our plans on some fundamental philosophy. That basic philosophy should be "honest citizenship." The real objective of socialization is to live together as a large family, all working for the common welfare. Society is based on the assumption that everyone will be honest in his dealings with others. In everyday practice, however, there are departures from honesty which bring corruption and strife. Dishonesty necessitates legislation, which in reality is an admission of failure in assuming social responsibilities.

Each of us is prone to think of himself as a privileged citizen who should be accorded special consideration. We contemplate our own interests selfishly and go ahead thoughtlessly, never caring for the welfare of others. To satisfy our own interests, we deliberately impose upon or exploit our fellow citizens. We make it necessary to devise and enforce laws to protect the common interests, but when these laws limit our individual activities, we demand special dispensations.

Basis of a Progressive Society

A progressive society must have as a basis a form of citizenship that is without graft, political plums, and personal interests. It is necessary that our individual ideals and characters be raised to the highest level.

Thus, honest citizenship becomes a challenge to the engineering graduate, in fact to the young graduate in any professional field. Individual success in a chosen field, as well as the general success of a professional group, requires that all activities be based on honest citizenship. A continued neglect of this aspect of honesty in civil duties will cause stagnation in the system of government which can only lead to strife among classes, peoples, and nations.

It is because the American people in the past have not paid sufficient attention to the honesty phase of citizenship that they are today paying a price—an exorbitant price in life, wealth, and material—to try to preserve the American system. But in paying that price, it must be realized that, unless each individual assumes his share of responsibility in civil life, he is not guaranteeing the preservation of the thing he is buying.

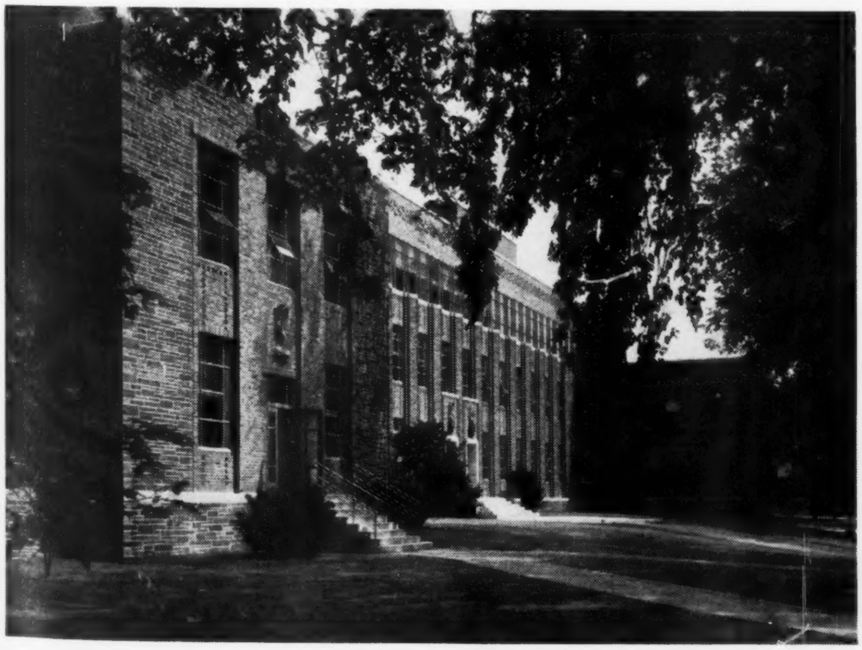
The Challenge of Victory

Thus, to the engineer comes a challenge—a challenge to build for victory, to fight for victory, and to lead from victory. Building is the immediate problem, for if the arms are not produced the fight will be in vain. Victory will be won by men imbued with a sense of spiritual values, and whose moral code and ideals are of the highest order.

Victory, however, will constitute the greatest challenge. It will be an engineering challenge, for the engineering profession will have to assume the leadership in building a postwar world. They will be called upon to furnish the technical inventiveness, required in the development of new industrial enterprises, which must be provided to furnish the millions of war workers with peacetime jobs. They must assist their Government in forming new economic policies. Finally, they must guide a war-minded and prejudiced people back to an industrious and progressive life—a life in which every individual may find some degree of enjoyment, and to which he may contribute his share in the creation of a better society.

Olin Hall of Chemical Engineering at Cornell University Dedicated on October 3, 1942

THE dedication of Olin Hall of Chemical Engineering at Cornell University on October 3, 1942, in memory of Franklin W. Olin, Jr., Cornell, 1912, marked a new era in the training of chemical engineers at that institution. It is the gift of Franklin W. Olin, a graduate in civil engineering in 1886, long a trustee of the University, and president of the Western Cartridge Company. Dr. Fred H. Rhodes who is the Herbert Fisk Johnson professor of industrial chemistry, who has served on the faculty of the University for twenty-two years, will be the director of the new school of chemical engineering.



OLIN HALL

Olin Hall houses 450 undergraduates and a proportionate number of graduate students. One unusual feature of the building is the large number of rooms designed for individual graduate students or of small groups of two or three working together on problems of common interest. Another feature is the three-story unit operations laboratory, occupying an entire wing—large enough for study in actual operation of full-sized commercial plants.

This laboratory houses the large pieces of equipment, such as evaporators, stills, absorption towers, and filter processes. To provide the necessary head room for some of the taller pieces, one large section is completely free of horizontal divisions. It is served by a traveling crane. A parallel section of equal width carries subway gratings at the first and second floor levels to provide operating platforms. A pipe shop, a machine shop, and a wood shop on the basement floor provide facilities for the construction and repair of the semi-plant-scale equipment. On the same floor is an analytical laboratory for use with unit operations.

The first floor of the main wing houses three of the four lecture rooms, the library and reading room, three of the five recitation rooms, and the computation room.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative, nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient, nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

New York	Boston, Mass.	Chicago	Detroit	San Francisco
29 W. 39th St.	4 Park St.	211 West Wacker Drive	100 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, 36, Draft 3A. College graduate offers 13 years of extremely broad plant-engineering experience in every phase of steel-producing and processing fields. Seeks executive or supervisory position in line with qualifications. Me-775.

GRADUATE MECHANICAL ENGINEER, 34, Lawyer, L.L.B. and J.S.D., admitted State, Federal, Patent bars, desires to increase responsibilities; married, one child. Two years' engineering; 10 years' legal, patent, and business experience. Me-776.

MECHANICAL ENGINEER, 34, technical graduate. Broad experience in engineering design and development. Experience also in industrial engineering and marine engineering. Location, preferably Massachusetts or New England; would consider other localities. Me-777.

MECHANICAL ENGINEER, graduate, over 45, with 26 years' experience in industrial power in steel and chemical plants, consulting, construction, operation, management, teaching. Civil Service rating as senior mechanical engineer. Me-778.

GRADUATE MECHANICAL ENGINEER, 32. Seven years' experience in manufacturing includes machine design, tool design, process, engineering of shell-machining plants, and head of engineering department. Me-779.

POSITIONS AVAILABLE

DESIGN ENGINEER, mechanical, with several years' experience in design and preferably operation of high-speed rotating equipment. Familiarity with basic machine elements and their application as well as grounding in fundamentals of analysis essential. Thorough knowledge of engineering materials an asset. Must have appreciation of principles of thermodynamics, mechanics of materials, and dynamics. Duties will be organization and development of over-all and detail mechanical design of variety of rotating equipment. $3300–$4200 year. Permanent. Pennsylvania. W-1200.

[1] All men listed hold some form of A.S.M.E. membership.

OFFICE MANAGER with knowledge of industrial procedures; to slightly lesser extent a mechanical aptitude and acquaintance with technical processes is highly desirable. Principal duty will be co-ordination of efforts of group of development engineers to accomplish large-scale project in limited space of time; construction of schedules, of engineering, ordering, manufacturing, and testing operations; expediting of subcontracting work and purchases; performance of liaison functions between development group and production and purchasing department within organization. $3300–$3900 year. Permanent. Pennsylvania. W-1201.

MANUFACTURING ENGINEERS, two, graduates with extensive experience with job-shop production methods. Principal duty will be investigation of manufacturing technique to furnish solutions for unusual design problems; will also supervise initial production of nonstandard elements of pilot models of newly developed products. This will include development and execution of special manufacturing and inspection methods. Salary open. Permanent. Pennsylvania. W-1202.

PERSONNEL MANAGER with technical background and experience; engineering experience necessary, with previous personnel experience desirable, but not essential. $2600–$3200 a year. Northern New Jersey. W-1229.

MECHANICAL ENGINEERS for war-plant work. (*a*) Experienced in layout, estimating, purchasing, etc. of equipment used in shell manufacturing, etc., i.e., drawing, reheating, finishing, and machine shop. (*b*) Experienced in piping and hydraulic equipment. (*c*) Experienced in quantity costs, installation of equipment, etc. $3900–$4200 year with opportunity for advancement with operating company when plant is completed. Central Pennsylvania. W-1230.

PRODUCTION CONTROL ENGINEERS for large company manufacturing high-precision machining operations in the instrument field. About $6000 a year. New York, N. Y. W-1237.

MECHANICAL ENGINEERS with considerable experience on erection of heavy mechanical equipment. Will be responsible for follow up and erection of hydraulic presses. Permanent. Also need similar man who is experienced in hydraulic piping. Must know high-pressure work. $3600–$4160 year. Pennsylvania. W-1240.

ENGINEERS. (*a*) Plant superintendent, aircraft plant. Must have had previous experience as superintendent or assistant in recognized aircraft company. Salary open. (*b*) Aircraft engineers experienced in aircraft methods, tooling, and production. $5000–$6000 year. (*c*) Assistant supervisor for stress-analysis work. Salary open. Pennsylvania. W-1243.

SERVICE MANAGER for large manufacturer of aeronautical appliances. Should be able to write clear, concise construction manuals, generally assist company clients in servicing apparatus, and be able intelligently to represent the company in field. Must be aeronautically inclined. $5000 year. Delaware. W-1251.

ASSISTANT TO GENERAL SUPERINTENDENT, mechanical, with degree from recognized university, for large metal-stamping plant. Must have some previous experience with pressers, tools, and dies and general machine shop. About $5000 year. New England. W-1262.

MAINTENANCE SUPERVISOR. Must be able to direct work of mechanics, such as pipefitters, plumbers, carpenters, electricians, etc. in maintenance of large industrial plant. Must be able to get along with labor. Permanent. $4200 year. New York, N. Y. W-1264.

FACTORY MANAGER, 35–50, to supervise plant manufacturing sheet-metal and cast-iron products. Must be acquainted with sheet-metal dies and pattern work. Will be required to supervise 170 men in construction of products from metal forming through assembly operations. Salary open. New York, N. Y. W-1269.

WELDING SUPERVISOR in charge of welding operations for company building steel barges. Will also direct company welding school. Forty welding units. $6000 year. Indiana. W-1295-CD.

MECHANICAL ENGINEERS AND DRAFTSMEN, male or female, preferably with experience as designer and builder of machinery. Should be familiar with materials-handling systems, such as conveyers, and have some executive ability. Will be in charge of supervision of engineering and partly of production, developing of new designs, as well as appraisal, supervision of purchasing, any nonroutine items; familiarity with engineering costs and production costs might be valuable. Salary open. New Jersey. W-1296.

PLANT SUPERINTENDENT for chemical process manufacturing with particular knowledge of high heating mediums, i.e., Dowd or Merrill systems. About $5000 a year. Interviews, New York, N. Y. Location, Ohio. W-1300.

OFFICE ENGINEER experienced in steel and concrete design, and preferably some piping. Knowledge of water supply desirable. $4500–$4800 year. Kentucky. W-1301.

DEVELOPMENT ENGINEER, mechanical, with some electrical or electrical-appliance background desirable. Will be for postwar development in consumer-goods field, in general. Prefer man draft-exempt. $6000–$7500 year. Connecticut. W-1309.

(*A.S.M.E. News continued on page 830*)

TIME STUDY ENGINEER with at least 10 years' experience in this work. General industrial engineering will not be acceptable. $5000–$6000 year. New York, N. Y. W-1313.

PURCHASING ENGINEER, graduate, with experience in purchasing machinery and machine tools. This experience essential. $4000–$5000 year. Southern Connecticut. W-1314.

ENGINEERS to work on factory equipment. Prefer college graduates in engineering or the equivalent in informal education. As work involves considerable detail, men should have temperament of this nature and be able to direct in limited way draftsmen on layout design. Prefer men with experience in purchase of engineering equipment and its installation. $2160–$3600 year. Temporarily Connecticut, later, Kansas City, Missouri. W-1315-C.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after November 25, 1942, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ADAMSON, ARTHUR V., New York, N. Y. (Rt)
ALDEN, CLIFFORD E., Rockville Centre, N. Y.
ANDERSON, JAS. W., JR., Detroit, Mich.
ASNIN, JAS. I., Wash., D. C.
BAECHLIN, ALFRED C., JR., Bayonne, N. J.
BARTON, EDWARD A., Mimico, Ontario, Can.
BOUCHARD, CONSTANT L., Speedway City, Ind.
BROSNAN, WALTER J., Terre Haute, Ind.
BROWN, ARNOLD K., Providence, R. I.
CLAESSEN, J. G., Colombo, Ceylon
DENSION, WM. E., Dayton, Ohio
DOOLEY, JAMES L., Los Angeles, Calif. (Re)
DRAGON, PETER F., Oakland, Calif.
ELLIS, BENJ. H., St. Albans, N. Y.
EMERICK, ROBERT H. (LT. COMDR.), Pearl Harbor, T. H.
FOWLER, ELIHU W., Englewood, N. J. (Rt)
GALE, WILLIAM K., Jackson Heights, N. Y.
GAWAIN, THEO. H., Mt. Carmel, Pa.
GEERTZ, ALLAN O., Hollidaysburg, Pa.
GISONNO, GEORGE L., Brooklyn, N. Y.
GOLAND, MARTIN, Buffalo, N. Y.
GRAY, EDW. G., Rocky River, Ohio
HULL, JOHN B., San Francisco, Calif.
HYDE, ERIC F., Birmingham, Mich.
KILBY, HUBERT S., Great Bend, Kansas
KOCH, CHAS. H., JR., Phila., Pa.
KOGAN, ZUCE, Chicago, Ill.
LADD, TALLMAN, Garden City, N. Y.
LANGENEGGER, HANS, Brooklyn, N. Y. (Rt & T)
LANGILL, ROSS E., Menominee, Mich. (Rt)
MARTINEZ TORNEL, PEDRO, Mexico, D. F.
MARTY, EDGAR O., New York, N. Y.
MAYBEE, BOB, Toronto, Ont., Can.
MEYER, A. H., New York, N. Y. (Rt)
MOELLER, HARRY A., Columbus, Ohio
MOYER, CHARLES W., Baltimore, Md.
O'KEEFE, PHILIP, Staten Island, N. Y.
OPSAHL, EMIL, Niagara Falls, Canada
PAGE, RAYMOND L., Albany, Calif.
PARR, GARNER C., Bala-Cynwyd, Pa.
PLUMMER, FRED L., Warren, Pa.
REYNOLDS, LARRY, Los Angeles, Calif.
SCHNEIDER, CAROL F., New Kensington, Pa.
SENTANCE, LAWRENCE C., Hamilton, Ont., Can.
SMITZER, LOUIS A., Chicago, Ill.
SODERBERG, OSCAR A., Detroit, Mich.
SPRAY, CLAUDE L., New York, N. Y.
STANTON, CURTIS H., Schenectady, N. Y.
TAYLOR, MARK H., Chicago, Ill.
VAN DER JAGT, BAREND G. H., New York, N. Y.
VAN SCHWARTZ, Z. C., Akron, Ohio
VIESSMAN, W., Baltimore, Md. (Rt)
WATSON, ROBERT, Hinsdale, Ill.
WENDLAND, CHAS. F., JR., Springfield Gardens, L. I.
WILLIAMS, ROBERT L., Cleveland, Ohio
ZALAHA, JOHN, Durango, Dgo. Mexico
ZARNOWSKI, FRANK J., Harrison, N. J.

CHANGE OF GRADING

Transfer to Fellow

KENT, ROBERT S., Brooklyn, N. Y.

Transfers to Member

ERICKSON, EDW. A., Brooklyn, N. Y.
FERRIS, EDWIN A., Ridgefield Park, N. J.
FOX, FRANKLIN H., New York, N. Y.
JARNAGIN, JAMES F., Detroit, Mich.
KAYES, WM. J., Tilbury, Ont., Can.
PEPOON, PHILIP W., Hampton, Va.
RUST, S. M., JR., Pittsburgh, Pa.
SHAAL, LESTER F., Edgewood, R. I.
TRIPP, WILSON, Manhattan, Kansas

1942 A.S.M.E. Memorial Biographies Sent on Request

MEMBERS of The American Society of Mechanical Engineers who wish to receive a copy of the 1942 Memorial Biographies of Deceased Members are requested to fill out and mail the accompanying form, or order by letter, addressed to the Secretary, A.S.M.E., 29 West 39th Street, New York, N. Y.

These Memorial Biographies, which have just recently been published, will form a part of the Society Records Section of the Transactions as bound for library use. The most of the biographies in this issue memorialize the lives of members of the Society deceased prior to 1940. Memorials of those who have died more recently are still in preparation. These will appear next year or later, depending on ability to assemble within the time allowed all of the necessary details, some of which are secured under great difficulties.

A.S.M.E.
29 West 39th St.
New York, N. Y.

Please send me a copy of the October, 1942, issue of Memorial Biographies.

NAME..............................

ADDRESS..............................

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A.S.M.E. Transactions for October, 1942

THE October, 1942, issue of the Transactions of the A.S.M.E. contains:

TECHNICAL PAPERS

- The Mercury-Vapor Process, A. R. Smith and E. S. Thompson
- Mercury for the Generation of Light, Heat, and Power, H. N. Hackett
- The Flow of a Flashing Mixture of Water and Steam Through Pipes, M. W. Benjamin and J. G. Miller
- Wind-Tunnel Tests to Establish Stack Height for Riverside Generating Station, H. L. von Hohenleiten and E. F. Wolf
- Problems in Water-Steam Cycle of Central Steam-Generating and Decentralized Control Systems, Parkchester, S. T. Powell and J. A. Dondero
- Radiation Configuration Factors Using Light in Furnace Models, Fred England and H. O. Croft
- Correlation of Coefficient of Friction With Drilling Torque and Thrust for Different Types of Cutting Fluids, A. O. Schmidt, W. W. Gilbert, and O. W. Boston
- Characteristics of Centrally Supported Journal Bearings, E. O. Waters

Necrology

THE deaths of the following members have recently been reported to headquarters:

BALDWIN, BERT L., May 29, 1942
CALMUS, F. A., August 2, 1942
DESCHWEINITZ, P. B., May 20, 1942
ELLINGWOOD, ELLIOT L., September 4, 1942
FROST, FRANK G., July 1, 1942
GUNAGAN, RICHARD H., August 26, 1942
HAMMERSMITH, G. W.*
SEELIG, ALFRED E., September 13, 1942
SMITH, EDWARD W. P., September 19, 1942
STUBBLEBINE, W. A., August 27, 1942
WEBSTER, HOWARD J., September 4, 1942

*Died in line of duty.

War Production and Man Power Key Topics at 1942 A.S.M.E. Annual Meeting, Nov. 30–Dec. 4

Hotel Astor to Be Headquarters for Five-Day Program of Technical Papers

UNDER the stress of war conditions that lie heavily upon all its members, The American Society of Mechanical Engineers will hold its Sixty-Third Annual Meeting at the Hotel Astor, New York, N. Y., November 30 to December 4. On Sunday, November 29, meetings of the Executive Committee of the Council and of the Group Delegates Conference will get under way in order to dispose of as much business as possible before the technical sessions are convened.

Great Variety of Technical Papers

The great variety of interests of members of the A.S.M.E. has increased rapidly in recent years and the number of sessions demanded by the Society's professional divisions for forums for the presentation of papers of interest to their members has grown to a point where the facilities of the Engineering Societies Building in New York have become overtaxed and inadequate. Hence, for the third consecutive year the Astor has been chosen as meeting headquarters. Here facilities are available not only for registration headquarters and meeting rooms for as many as five concurrent sessions, but numerous restaurants and private dining rooms afford opportunity for general and committee luncheons and dinners as well as service to individuals and small parties.

Society's Rooms Redecorated

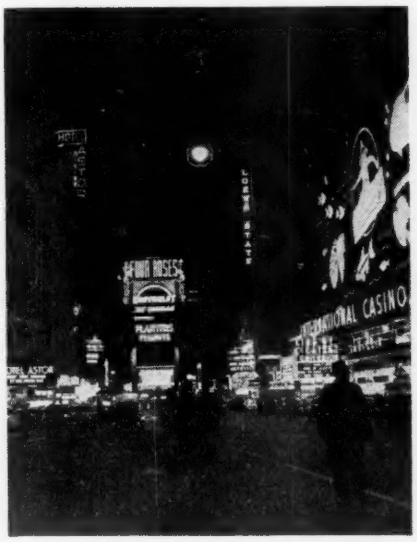
Although the Astor will be the headquarters of the meeting and technical sessions, the Society's headquarters in the Engineering Societies Building at 29 West 39th Street holds a particular attraction for members this year as the public rooms on the eleventh floor have been redecorated in a manner that will inspire a sense of pride in every member visiting New York. Members are particularly urged not to miss the opportunity of viewing the redecorated rooms. In the Engineering Societies Building there will also be found the New York office of the Engineering Societies Personnel Service, which now has branch offices in several cities, and the Engineering Societies Library in which the A.S.M.E. Library collection is incorporated and which has been particularly active in recent months in serving engineers with its popular search, photostat, and translation services, and in the loan of its books and periodicals to members wherever they may be situated throughout the United States. Members should take the opportunity to visit the Library and inform themselves of the various services that are at their disposal and that are supported by their dues.

War Production and Man Power Key Topics

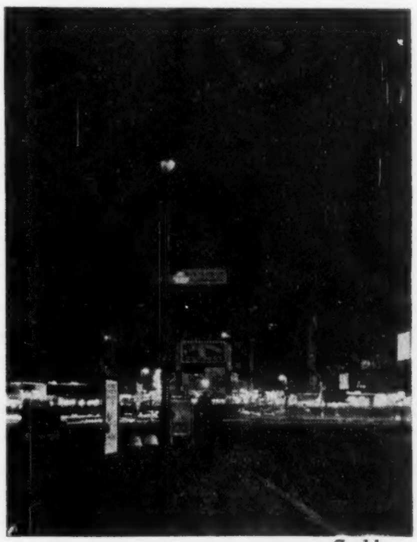
War production and training of man power for war production are essential topics for the discussion of engineers in the present emergency. No excuse can be found for the holding of meetings which take keymen from posts of responsibility in support of the armed forces unless the subject matter of discussion is directed constructively and insistently toward the techniques of improved production, the management of war industries, the vexing

(*Continued on page 836*)

TIMES SQUARE IN 1917



JUST BEFORE "PEARL HARBOR"



Cushing

"IN THE DIMOUT"

(Three views of Times Square with the Astor Hotel, headquarters for the 1942 A.S.M.E. Annual Meeting, in the background taken in different lighting conditons.)

Program of A.S.M.E. Sixty-Third Annual Meeting

New York, N. Y., Nov. 30–Dec. 4, 1942

Headquarters, Hotel Astor

SUNDAY, NOVEMBER 29

9:30 a.m.

Meeting Executive Committee of Council
Conference Local Sections Delegates

12:30 p.m.

Luncheon Council and Local Sections Delegates

2:30 p.m.

Meeting of Council
Meeting Local Sections Delegates

7:00 p.m.

Meeting of Council with Professional Divisions, Section Delegates, and Committee Representatives

MONDAY, NOVEMBER 30

9:00 a.m.

Local Sections Delegates

9:30 a.m.

Meeting of Council
Conference Professional Divisions Representatives

12:30 p.m.

Luncheon—Importance of Intuitive, Inventive, Ingenious Faculties in Engineering—Auspices of Committee on Education and Training for the Industries

2:30 p.m.

Session on Ingenuity

Helicopter Film

Creative Engineering, Invention, Intuition, by Igor Sikorsky, Vought-Sikorsky Aircraft Corporation, Stratford, Conn.

Discussion:

A. R. Cullimore, president, Newark College of Engineering, Newark, N. J.

C. I. Barnard, president, New Jersey Bell Tel. Co., Newark, N. J.

Lawrence Langner, secretary, Inventors' Council, New York, N. Y.

K. K. Paluev, Transformer Division, General Electric Company, Pittsfield, Mass.

[1] To be preprinted for 1942 Annual Meeting.

MONDAY (*continued*)

4:00 p.m.

Business Meeting
Local Sections Delegates Conference *following Business Meeting*

8:00 p.m.

Council Meeting

Management

Job Standardization and Work Simplification, 1932–1942, by H. B. Maynard, president, Methods Engineering Council, Pittsburgh, Pa.

Wage Plans During 1932–1942, by J. M. Juran, assistant administrator, Office of Lend-Lease Administration, Washington, D. C.

Symposium on Cutting of Metals

(Papers to be announced later)

Aviation—Wood Industries

Use of Plywood in Airplane Construction, by G. A. Allward, manager, accessories and Duramold parts department, Hughes Aircraft Co., Culver City, Cal.

Introduction to Use of Plywood in Airplane Construction, by Alexander Klemin, New York University, New York, N. Y.

Molded Plastic-Bonded Veneer and Wood in Aircraft Construction, by Robert J. Nebesar, chief engineer, Universal Moulded Products Corporation, Bristol Aircraft Division, Bristol, Va.

Panel Discussion

Discovery and Encouraging Originality, Initiative, and Resourcefulness in Young Americans

The Public Vocational Schools and Creative Ability, by Alonzo D. Grace, Commissioner of Education, department of education, Hartford, Conn.

What the Technical Institutes Can Do, by Arthur C. Harper, president, Wyomissing Polytechnic Institute, Wyomissing, Pa.

What the Engineering College Can Do, by Paul B. Eaton, Lafayette College, Easton, Pa.

What the Local Sections Can Do, by James N. Landis, Consolidated Edison Co., New York, N. Y.

MONDAY (*continued*)

8:00 p.m.

What Industry Can Do, by W. E. Johnson and K. K. Paluev, General Electric Company, Schenectady, N. Y.

Pride of America, by A. A. Potter, dean, schools of engineering, Purdue University, Lafayette, Ind.

Tube Expanding

The Holding Power and Hydraulic Tightness of Expanded Tube Joints: Analysis of the Stress and Deformation, by J. N. Goodier, professor of engineering mechanics, Cornell University, Ithaca, N. Y., and G. J. Schoessow, mechanical engineer, The Babcock & Wilcox Co., Barberton, Ohio

Experimental Investigation of Tube Expanding, by E. D. Grimison, mechanical engineer, The Babcock & Wilcox Co., New York, N. Y., and G. H. Lee, assistant professor of engineering mechanics, Cornell University, Ithaca, N. Y.

Practical Aspects of Making Expanded Joints, by C. A. Maxwell, superintendent of erection, The Babcock & Wilcox Co., Barberton, Ohio

TUESDAY, DECEMBER 1

9:00 a.m.

Meeting Local Sections Delegates

9:30 a.m.

Increased Adaptability of Workers to Job Requirements

The Increase in the Adaptability of War Department Employees to Job Requirements, by William H. Kushnick, director of civilian personnel and training, War Department, Washington, D. C.

F. E. Searle, superintendent, Ford Trade Schools, Dearborn, Mich.

J. W. Barker and Frank Cushman, Navy Building, Washington, D. C.

Fluid Meters

The Effect of Installation on the Coefficients of Venturi Meters,[1] by W. S. Pardoe, professor, department of civil engineering, University of Pennsylvania, Philadelphia, Pa.

(Program continued on page 833)

TUESDAY (*continued*)

9:30 a.m.

Results of Tests on Volumeters for Liquid Hydrocarbons, by R. J. S. Pigott, staff engineer and E. W. Jacobson, design engineer, Gulf Research & Development Co., Pittsburgh, Pa., and E. E. Ambrosius, professor, department of mechanical engineering, University of Kansas, Lawrence, Kansas

An Investigation on the Metering of Pulsating Flow, by S. R. Beitler, associate professor, hydraulic engineering, The Ohio State University, Columbus, Ohio

A Progress Report on Flow-Nozzle Coefficients, by H. S. Bean, senior physicist, chief, gas-measuring instruments section, National Bureau of Standards, Washington, D. C.

Fuels—I

Pulverized Coal in the Metallurgical Industries, by C. F. Herington, Amsler-Morton Co., Pittsburgh, Pa.

Developments in Spreader Stoker Firing, by R. L. Beers, Detroit Stoker Co., Detroit, Mich.

Industrial Instruments and Regulators—I

Discussion treatise on Introduction to Control Engineering, by E. S. Smith, C. J. Tagliabue Manufacturing Co., Brooklyn, N. Y.

Discussion of Process Lags in Automatic Control Circuits,[1] by J. G. Ziegler, sales-engineering department, Taylor Instrument Companies, Rochester, N. Y., and N. B. Nichols, Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. (paper first presented at 1942 Fall Meeting at Rochester)

Machine Design

New Five-Bar and Six-Bar Linkages in Three Dimensions,[1] by Michael Goldberg, Ordnance Engineer, Bureau of Ordnance, Navy Department, Washington, D. C.

A Brief Account of Modern Kinematics,[1] by A. E. R. deJonge, adjunct professor, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Dynamics

Harmonic Analysis of a Hook's Joint Motion,[1] by F. A. Hiersch, University of Michigan, Ann Arbor, Mich.

Free Lateral Vibrations of a Cantilever Beam With a Terminal Dashpot, by Edward J. McBride, Elliott Co., Jeannette, Pa.

The Critical Speeds of a Rotor With Unequal Shaft Flexibilities Mounted in Bearings of Unequal Flexibility,[1] by H. Poritsky, W. R. Foote, and J. J. Slade, Jr., engineering general department, General Electric Company, Schenectady, N. Y.

TUESDAY (*continued*)

12:30 p.m.

Management Luncheon—Ten Year Progress Report, Harold V. Coes, President-Elect, A.S.M.E.

2:00 p.m.

Industrial Instruments and Regulators—II

Measurement of High Temperatures in High-Velocity Gas Streams,[1] by W. J. King, General Electric Company, Schenectady, N. Y.

Desirable Characteristics of Valves and Final Control Elements for Cascade Control,[1] by P. W. Keppler, engineer, Sanderson & Porter, New York, N. Y.

Fuels—II

Development and Performance of a Coal-Fired Unit Heater, by R. M. Rush, Dravo Corporation, Pittsburgh

Conversion of Domestic Heating Appliances for Coal Firing, by A. J. Johnson, Anthracite Institute, Primos, Pa.

Lubrication

Static Friction,[1] by Walter Claypoole, research associate in mechanical engineering, Columbia University, New York, N. Y.

Experiments on Bearing Performance, by Paul G. Exline, engineer, Gulf Research & Development Co., Pittsburgh

Steel Castings

Conversion in Ordnance Manufacture, by Thorton Lewis, Deputy Chief, Production Service Branch, Industrial Division, Ordnance Department, Washington, D. C.

Aviation—I

Aerodynamic Center, Control and Stability, by Hans Reissner, Illinois Institute of Technology, Chicago, Ill.

Recent Antifriction Bearing Development for Aviation Engines, by Thomas Barish, Engineering & Research Corporation, Hyattsville, Md.

Possibilities and Limitations of the Carburetor Aircraft Engine, by G. P. Toews, engineer, Naval Aircraft Factory

2:30 p.m.

Cost and Budgetary Control

Progress in Cost Control, 1932–1942, by Wyman P. Fiske, Massachusetts Institute of Technology, Cambridge, Mass.

Progress in Budgetary Control, 1932–1942, by Clinton W. Bennett, Corley & Marvin Co., Boston, Mass.

TUESDAY (*continued*)

8:00 p.m.

Power

The Application of Turbine Supervisory Instruments to Power-Generating Equipment, by J. L. Roberts and H. M. Dimond, General Electric Company, Schenectady, N. Y.

1825 Lb Pressure Topping Unit With Special Reference to Forced-Circulation Boiler,[1] by F. S. Clark, Stone & Webster Engineering Corporation, Boston, Mass., H. S. Rosencrants, and W. H. Armacost, Combustion Engineering Co., New York, N. Y.

Industrial Conservation

Sound motion pictures on Scrap Salvage and Materials Conservation

Aviation—II

Effectiveness of Shear-Stressed Rubber Compounds in the Isolation of Vibrating Machinery,[1] by Baxter C. Madden, Jr., Air Corps, Army Air Forces Matériel Center, Wright Field, Dayton

Control of Pressure in Aircraft Cabins, by Bruce Del Mar, The Douglas Aircraft Co., Santa Monica, Calif.

Problems in Aircraft Structural Research, by F. R. Shanley, chief structures engineer, Lockheed Aircraft Corporation, Burbank, Cal.

Petroleum

Mathematical Analysis of Gas Pipe-Line Design, by H. C. Lehn, Worthington Pump & Machinery Corp., Buffalo, N. Y.

WEDNESDAY, DECEMBER 2

9:30 a.m.

Management Attitudes

Management Attitudes, William L. Batt, Office of Production Management, Washington, D. C.

How Should Management Attitudes Change, by Melvin J. Evans, Chicago, Ill.

Foreman Training, by Wendell M. Nelson, assistant to manager, General Electric Company, Schenectady, N. Y.

Textile

Evaporative Cooling Primer for Textile Management,[1] by M. H. Irons, American Moistening Co., Providence, R. I.

Infra-Red Drying of Textiles, by George Fischer, Infra-Red Ray Equipment Corporation, New York, N. Y.

Plasticity

Creep and Relaxation of Oxygen-Free Copper,[1] by E. A. Davis, research engineer, Westinghouse Research Laboratories, E. Pittsburgh, Pa.

(*Program continued on page 834*)

WEDNESDAY (*continued*)

9:30 a.m.

A Principle of Maximum Plastic Resistance,[1] by Michael A. Sadowsky, associate professor, department of mathematics, Illinois Institute of Technology, Chicago, Ill.

The Distribution of Strains in the Rolling Process,[1] by C. W. MacGregor, associate professor of mechanical engineering, and L. F. Coffin, Jr., instructor, department of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Panel Discussion on Boiler-Water Problems

Boiler-Water Problems in Connection With High-Temperature, High-Pressure Steam Generation

(1) General Presentation of Problems Encountered

(2) Major Problems:
  (*a*) Boiler-Water Scales
  (*b*) Carry-over
  (*c*) Turbine-Blade Deposits

Oil and Gas Power

Investigation of Large Diesel-Engine Wristpins, Pistons, and Crankcase Explosions,[1] by Frank E. Faast, office of supervisor of shipbuilding, U. S. Navy, Tampa, Fla.

Rating Supercharged Engines on the Basis of the Mean Temperature of the Cycle, by Ralph Miller, Worthington Pump & Machinery Corporation, Buffalo, N. Y.

Inlet-Air-Temperature Corrections in a Roots Supercharger, by Frederick A. Hiersch, University of Michigan, Ann Arbor, Mich. (by title)

Definition of Volumetric Efficiency of Internal-Combustion Engines, by P. H. Schweitzer, The Pennsylvania State College, State College, Pa. (by title)

12:30 p.m.

Textile Luncheon

The Organizations of Textile Research for War, by Fessenden S. Blanchard, president, Textile Research Institute, New York, N. Y.

Student Luncheon

2:00 p.m.

Symposium on Industrial Training

1 Indentured Apprentice Training in Wartime

What Practical Steps May Be Taken to Improve and Enhance the Dignity of the Apprentice, by John B. Chalmers, director of training school, Yale & Towne Manufacturing Company, Stamford, Conn.

WEDNESDAY (*continued*)

2:00 p.m.

Practical Results of the "Learner Training Program," by R. L. Witham, training director, Sperry Gyroscope Co., Brooklyn, N. Y.

What Is the Experience in the Training and Development of Tool Designers by the Apprentice System, by Frank R. Wodtke, director of apprentice training, Hyatt Bearing Division, General Motors Corporation, Harrison, N. J.

What Can Be Done to Improve and Accelerate Supplementary Instruction in the Co-Operative Apprentice Program, by Robert C. Beebe, director, Essex County Vocational Schools, Newark, N. J.

What Happens to the Apprentice Graduate in Later Years, by Ray E. Ellis, supervisor of apprentices, General Electric Co., Schenectady, N. Y.

2 Pre-College Vocational Guidance for Employment in Industry, by R. L. Sackett, E.C.P.D. Vocational Guidance Committee; dean of engineering, emeritus, The Pennsylvania State College

3 The Effectiveness and Value of the E.S.M.W.T. Program for Industrial Training at the Engineering Level, by Thorndike Saville, dean, college of engineering, New York University, New York, N. Y.

4 Special Company-Sponsored Programs for the Recent Engineering-College Graduate Entering Industrial Employment, by H. C. Madsen, manager, technical employment and training, Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Boiler Feedwater Studies

A Practical Way to Prevent Embrittlement Cracking,[1] by A. A. Berk, associate chemist, Eastern Experiment Station, U. S. Bureau of Mines, College Park, Md., and W. C. Schroeder, assistant chief, Fuels and Explosives Service, U. S. Bureau of Mines, Washington, D. C.

Boiler Embrittlement, by Carl A. Zapffe, Battelle Memorial Institute, Columbus, Ohio

Elasticity

The Center of Shear Again,[1] by W. R. Osgood (by title), Materials Engineer, U. S. Department of Commerce, National Bureau of Standards, Washington, D. C.

Stresses and Displacements in a Rotating Conical Shell,[1] by J. L. Meriam, supercharger engineering department, General Electric Company, West Lynn, Mass.

WEDNESDAY (*continued*)

2:00 p.m.

The Influence of the Shape of an Elastic Inclusion on the Transverse Flexure of Thin Plates[1], by Martin Goland, Curtiss-Wright Corporation, research laboratory, Buffalo, N. Y.

Three-Dimensional Photoelasticity as Applied to the Study of Threaded Fastenings, by M. Hetényi, research engineer, Westinghouse Research Laboratories, E. Pittsburgh, Pa.

Aviation—III

Military Airplane Performance, by Nathaniel F. Silsbee, Major Air Corps, Air Information Section, Bureau of Public Relations, War Department, Washington, D. C.

Cargo-Glider Pickup, by Richard Du Pont, president, All American Aviation, Inc., Wilmington, Del.

Oil and Gas Power—Railroad

Diesel Locomotive Progress Report Under War Conditions

Speakers:

Paul Turner, eastern regional manager, Electro Motive Corporation

Max Essl, chief engineer, Diesel Division, Baldwin Locomotive Works

P. H. Hatch, assistant mechanical engineer, New York, New Haven & Hartford Railroad

Wayne E. Lynch, American Locomotive Co. and General Electric Company

W. S. H. Hamilton, equipment electrical engineer, New York Central System

A. K. Galloway, Baltimore & Ohio Railroad Co.

Progress Report on Gas Turbine Locomotive Operation, by Paul R. Sidler, resident engineer, Brown, Boveri & Co., Ltd.

Future Diesel Locomotive Possibilities, by P. B. Jackson, Aluminum Company of America

7:00 p.m.

Annual Banquet

THURSDAY, DECEMBER 3

9:30 a.m.

Nominating Committee

Hydraulics

Centrifugal-Pump Performance as a Function of Specific Speed, by A. J. Stepanoff, development engineer, Ingersoll-Rand Co., Phillipsburg, N. J.

Railroad—I

Speakers:

F. K. Mitchell, assistant general superintendent, motive power and rolling stock, New York Central System

(*Program continued on page 835*)

THURSDAY (*continued*)

9:30 a.m.

Otto S. Beyer, director, Division of Transport Personnel, Office of Emergency Management, Washington, D. C.

John Roberts, Chief, M.P. & Car Equipment, Canadian National Railways

Mechanical Springs

Volute-Spring Formulas,[1] by C. J. Holland, president, Holland Co., Chicago, Ill.

The Testing of Volute Springs, by Bernhard Sterne, experimental engineer, Chrysler Corporation, Detroit, Mich.

Notes on Secondary Stresses in Volute Springs,[1] by Henry O. Fuchs, engineer, General Motors Corporation, Detroit, Mich.

Plastics

Mechanical Tests of Cellulose Acetate—Part III, by William N. Findley, associate in Theoretical and Applied Mechanics, College of Engineering, University of Illinois, Urbana, Ill.

Physical Properties of Laminated Plastics, by R. W. Barber, chief engineer, Panelyte division, St. Regis Paper Co., Trenton, N. J.

The Effects of Continued Heating on Mechanical Properties of Molded Phenolic Plastics, by D. Telfair, R. U. Haslanger, and T. S. Carswell, plastics division, Monsanto Chemical Co., Springfield, Mass.

Heat Transfer—I

The Dynamic Viscosity of Nitrogen, by W. L. Sibbitt, G. A. Hawkins, and H. L. Solberg, Purdue University, Lafayette, Ind.

Tests of Steam Pipe Insulation, by E. A Allcut, University of Toronto

12:30 p.m.

Railroad Division Luncheon

2:00 p.m.

Railroad—II

Speakers:

Hon. Paul V. McNutt, chairman, War Manpower Commission, Washington, D. C.

Arthur C. Willard, president, University of Illinois, Urbana, Ill.

Dorothy Sells, chief, Personnel Supply Section, Office of Defense Transportation, Washington, D. C.

Julian S. Hatcher, U.S.A., Chief Military Training Division, Washington, D. C.

Rubber

Data on Static and Dynamic Fatigue of Rubber, Francis L. Yost, U. S. Rubber Co.

THURSDAY (*continued*)

2:00 p.m.

Rubber Substitutes, by E. G. Kimmich, development engineer, Goodyear Tire & Rubber Co., Akron, Ohio

Progress in Plastics and Rubber During the Past Year, by Gordon M. Kline, National Bureau of Standards, and F. L. Yerzley

Symposium on Feedwater Heating Cycles

Discussion by leading engineers of mauufacturing, designing, and operating companies of the economic significance of difference in feedwater heating cycles and arrangements, particularly with reference to whether some standardization could be effected

Heat Transfer—II

The Influence of Nonuniform Development of Heat Upon the Temperature Distribution in Electrical Coils and Similar Heat Sources of Simple Form, by Max Jakob, Illinois Institute of Technology, Chicago, Ill.

The Numerical Solution of Heat-Conduction Problems, by Howard Emmons, Harvard University, Cambridge, Mass.

Aviation—Applied Mechanics

Measurement of Dynamic Strain, by C. R. Dohrenwend, chairman in charge mechanics, and W. R. Mehaffey, associate physicist, Armour Research Foundation, Chicago, Ill.

A Survey of the Theory of Wing Flutter, by Eric Reissner, Massachusetts Institute of Technology, Cambridge, Mass.

8:00 p.m.

Symposium on Marine Power

Low Speed, Direct-Connected Marine Diesel Engines, by G. McConechy, chief engineer, Sun Shipbuilding & Dry Dock Co., Chester, Pa.

Marine Diesel Engines With Reduction-Gear Sets, by B.V.E. Nordberg, Nordberg Manufacturing Co., Milwaukee, Wis.

Electric and Hydraulic Couplings on Diesel Engines With Reduction-Gear Sets, by H. C. Coleman, manager, marine section, industry engineering department, Westinghouse Electric & Manufacturing Co., E. Pittsburgh, Pa.

Hydraulic Couplings for Marine Diesels, by R. G. Olson, The American Blower Corporation, New York, N. Y.

Diesel Auxiliary Generator Sets, by Ralph Boyer, Cooper-Bessemer Corporation, Mt. Vernon, Ohio

Diesel Engine Governing, by H. W. Thorell, Woodward Governor Co., Rockford, Ill.

THURSDAY (*continued*)

8:00 p.m.

Panel Discussion on Shell and Tube Heat Exchangers

Effect of Material Restrictions and Priorities on the Design of Heat Exchangers

Discussers: Messrs. R. A. Bowman, C. C. Lockhart, E. H. Seider, T. Tinker

Heat Transfer and Pressure Drop in Shell and Tuber Exchangers in All Regions of Flow

Discussers: Messrs. A. P. Colburn, R. E. Daubner, T. B. Drew, E. D. Grimison

Critical Pressure Steam Boilers—Effect of Metal Temperature, Metals

Corrosion of Unstressed Alloy-Steel Specimens by Steam at Temperatures up to 1800 F, by G. A. Hawkins, associate professor, mechanical engineering, H. L. Solberg, head, school of mechanical engineering, J. T. Agnew, research assistant, and A. A. Potter, dean, schools of engineering, Purdue University, Lafayette, Ind.

Effect of Dioxidation Practice on Creep Strength of Carbon-Molybdenum, Steel at 850 and 1000 F, by Richard F. Miller, Research Laboratory, U. S. Steel Corporation, Kearny, N. J.

Manufactured and Natural Gas

Defense Developments in Distribution Work, by C. S. Goldsmith, engineer of distribution, Brooklyn Union Gas Co., Brooklyn, N. Y.

Description of the Lirette-Mobile Pipe Line, by W. B. Poor, supervising engineer, United Gas Pipe Line Co., Shreveport, La.

FRIDAY, DECEMBER 4

9:30 a.m.

Council Meeting

Furnace Heat Transmission

Further discussion on paper, Studies of Heat Transmission Through Boiler Tubing at Pressures From 500 to 3300 Psi,[1] presented at 1941 Annual Meeting by Messrs. Davidson, Hardie, Humphreys, Markson, Mumford, and Ravese

Sugar

Williamson Clarifier Phosphoric Acid Defecation—History and Development, by George P. Meade, manager, Colonial Sugars Co., Gramercy, La.

High-Speed Centrifugal Machines, by G. E. Stevens, technologist, Western States Machine Co., Hamilton, Ohio

Informal Discussion on Bone-Char Investigation, by A. B. Babcock, superintendent, Brooklyn Refinery, American Sugar Refining Co., Brooklyn, N. Y.

(Continued from page 831)

questions of man power and its proper training, and the general inspiration to better and more effective performance of necessary tasks that comes with personal contact and interchange of views with engineers similarly engaged. Hence all program-making groups within the Society have had as their objective the aiding of mechanical engineers in their important job of producing for victory.

Society Affairs to Be Stressed

Society affairs cannot, of course, be neglected, because it is upon the vigor and resourcefulness of the society as an organization that its usefulness depends. Committees charged with the development of research and engineering techniques such as standardization, test codes, and safety are also active in wartime because upon the discharge of their duties depends the success of many important industrial activities. Nor must the social aspects of such a large gathering as the Annual Meeting of the A.S.M.E. be neglected for here the re-creation of the inspirational values may be accomplished and that needful change from day-by-day tasks used to good advantage. Opportunity is afforded during these social occasions for members not only to relax and enjoy the renewal of friendships—an important aspect of Annual Meeting activity in wartime as well as peacetime—but also to listen to addresses by men of national importance who take time out to deliver their messages to the mechanical engineers of the nation. Even war is no excuse for the Society to abandon its customary function of honoring men who have distinguished themselves and their profession by their accomplishments. A group of these men, recipients of medals and honorary memberships, will be honored according to the best A.S.M.E. traditions, and no one will want to miss the opportunity to see and meet these distinguished fellow engineers.

Cushing

THE NEW YORK PUBLIC LIBRARY "DIMMED OUT" IN MOONLIGHT

Preprints of 1942 Annual Meeting Papers

As USUAL, a considerable number of papers to be presented at the 1942 A.S.M.E. Annual Meeting to be held at the Hotel Astor, New York, N. Y., Nov. 30 to Dec. 4, 1942, will be available in preprint form in advance of the Meeting.

The program of the Meeting which appears on pages 832–835 of this issue indicates the papers to be ready (so far as is known at press date) for distribution in advance of the Meeting. A few additional papers, received too late for preprinting in advance of this issue date, will be available at the sessions. Requests for papers should be addressed to the Secretary, The American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y. In so far as possible, orders received in time will be filled.

A charge will be made for preprints of A.S.M.E. papers. The following schedule of prices will be in effect:

Size of papers, pages	Price per copy: At registration desk	Price per copy: By mail
12 or fewer	$0.10	$0.15
16	0.15	0.20
20	0.20	0.25
24 or more	0.25	0.30

Remittance should accompany orders which should be sent to A.S.M.E. Headquarters, 29 West 39th St., New York, N. Y.

Since it is not possible to state at this writing the number of pages in these papers, we suggest that twenty cents be forwarded for each preprint ordered. Any over-remittance will be refunded in stamps.

Full Program of Technical Papers Offered

For months the program-making groups of the Society, that is, the professional divisions and the technical and other committees, have been hard at work on a program that will be larger than any heretofore presented at an A.S.M.E. Annual Meeting. The pressure of war work has made it difficult to secure in advance for preprinting as large a percentage of the technical papers as is usually available at a meeting of this type. However, the authors are certain to make up in the timeliness and immediate importance of their presentation what may be lost by the lack of a complete set of preprinted papers. Discussion should be as active and as stimulating as it could be had it been possible to get preprints of papers into the hands of discussers, and, because of the extemporaneous nature of the comments that will be heard, personal attendance is more than ever necessary and will be rewarded by much "off the record" comment. Naturally, the necessity for secrecy has made it impossible to present some of the subjects planned for discussion at all and will hamper some speakers in talking as freely about details as would be desired or expected in peacetime. However, there remains a sufficient amount of new and valuable information to provide the average member with abundant reasons for taking time out to spend the first week in December at the meeting. He will go away refreshed intellectually and better prepared to take up the task that lies before him in his own particular job.

Ingenuity to Be Discussed

Public sessions are scheduled to commence on Monday noon at a luncheon under the auspices of the Committee on Education and Training for the Industries. This committee has been developing a series of programs of national importance and wide appeal, and also of unique quality as to subject matter. At Monday's luncheon the subject for discussion will be the importance of intuitive, inventive, ingenious faculties in engineering. So impressed was the Council of the Society with the value of the program proposed by the Committee

Cushing

"CAMERA ANGLE" SHOT UPWARD AT 70-STORY R.C.A. BUILDING IN ROCKEFELLER CENTER

that it directed the Committee on Meetings and Program to arrange for a place on the program that would be free from the competition of other sessions. Monday's luncheon and the hours immediately following it were therefore set aside for this purpose.

At 2:30 p.m. the distinguished aeronautical engineer, Igor Sikorsky, will display a motion-picture film showing his famous helicopter and will speak on the subject, "Creative Engineering, Invention, and Intuition," which is one of his hobbies. Invited to open the discussion which will follow Mr. Sikorsky's talk are A. R. Cullimore, president, Newark, College of Engineering, C. I. Barnard, president, New Jersey Bell Telephone Company, Lawrence Langner, secretary Inventors' Council, and K. K. Paluev, of the General Electric Company.

Registration Fee for Non-Members at the 1942 Annual Meeting

There will be a registration fee of $2 for nonmembers attending the 1942 A.S.M.E. Annual Meeting. For nonmembers wishing to attend just one session the fee will be $1. This is in accordance with the ruling of the Standing Committee on Meetings and Program.

Members wishing to bring nonmember guests may avoid this fee by writing to the Secretary of the Society before November 23 asking for a guest-attendance card for the Annual Meeting. The card, upon presentation by a guest, will be accepted in lieu of the registration fee. Guests are limited to *two per member.*

The Annual Business Meeting Will Be Called to Order at 4:00 P.M.

Following up the afternoon's discussion, there will be an evening session under the auspices of the Committee on Education and Training for the Industries which will take the form of a panel discussion on the subject, "Discovering and Encouraging Originality, Initiative, and Resourcefulness in Young Americans." The importance of these two sessions to the nation at the present time and in the years of reconstruction and economic adjustment to postwar conditions cannot be overestimated. Predictions are that both sessions will attract a record attendance.

Taking part in the evening panel will be Alonzo D. Grace, commissioner of education of the State of Connecticut, who will talk on the public vocational schools and creative ability; Arthur C. Harper, president, Wyomissing Polytechnic Institute, whose subject is "What the Technical Institutes Can Do;" Paul B. Eaton, Lafayette College, who will deal with what the engineering college can do; James N. Landis, Consolidated Edison Company of New York, Inc., and chairman of the A.S.M.E. Committee on Local Sections, who will explore the possibilities of what the A.S.M.E. Local Section can do; W. E. Johnson and K. K. Paluev of the General Electric Company, who will treat the subject from the point of view of industry; and Dean A. A. Potter, of Purdue University, whose topic is "Pride of America."

Monday Evening Program

Running concurrently with the session on creative ability just noted will be four other sessions at which technical papers and discussions will be presented. The A.S.M.E. Management Division is sponsoring a session on job standardization and work simplification; the Production Engineering Division, a session which will take the form of a symposium on metal cutting from the users' point of view; the Aviation and Wood Industries Divisions, a joint session on plywood and plastic-bonded veneer in aircraft; and the Research Committee and Power Division, a joint session on tube expanding.

Adaptability of Workers

For Tuesday morning five concurrent sessions are scheduled. A joint meeting of the Management Division and the Committee on Education and Training for the Industries will discuss the subject "Increased Adaptability of Workers to Job Requirements." Four papers are scheduled for presentation at the session sponsored by the Fluid Meters Committee.

Pulverized coal in the metallurgical industries and developments in spreader-stoker firing will be discussed at the fuels session. The remaining sessions are sponsored by the Committee on Instruments and Regulators and the Machine Design Committee of the Production Engineering Division.

The Applied Mechanics Division is sponsoring a session on dynamics, with three papers being presented for discussion.

Ten-Year Progress Report on Management

Tuesday's luncheon will afford opportunity for the presentation of the A.S.M.E. Management Division's "Ten-Year Progress Report." Harold V. Coes, president-elect of the Society, will preside at the luncheon.

Operating Results of Forced-Flow Boiler Plant

Six more concurrent sessions will follow the Tuesday luncheon. The subjects under discussion at these sessions will be cost and budgetary control, sponsored by the Management Division, industrial instruments and regulators, fuels, lubrication, steel castings, and aviation problems.

At eight o'clock Tuesday evening the Power Division will hold a session on turbine supervisory instruments and operating results at an eastern electric power plant where a forced-circulation boiler has recently been placed in service.

There will also be a session on industrial conservation and one sponsored by the Aviation Division with papers on the effectiveness of shear stressed rubber compounds in the isolation of vibration, the control of pressure in aircraft cabins, and problems of research for aircraft.

Batt to Speak at Management Session

The pattern of five concurrent sessions, which continues throughout the week, offers no letup on Wednesday. In the morning, under the auspices of the Management Division, W. L. Batt, Office of Production, Washington, D. C., will speak on "Management Attitudes." Other speakers at this session are Melvin J. Evans, of Chicago, and Wendell M. Nelson, of the General Electric Company.

Concurrently with the Management session the Textile Division will present two papers at its session and there will be three papers on plasticity presented under the auspices of the Applied Me-

Official Notice

A.S.M.E. Business Meeting

THE Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held Monday afternoon, November 30, 1942, at 4:00 p.m. at the Hotel Astor, New York, N. Y., as a part of the Annual Meeting of the Society.

(*Signed*) C. E. DAVIES

Secretary

chanics Division. The Power Division and the Joint Research Committee on Boiler Feedwater Studies, also on Wednesday morning, offer a panel discussion on boilerwater problems in connection with high-temperature, high-pressure steam generation.

Four papers, two to be presented by title, comprise the program of the Oil and Gas Power Division, also scheduled for Wednesday morning.

Textile and Student Luncheons

A break in the heavy schedule of technical papers is afforded on Wednesday noon by an opportunity to attend one of two luncheons. The luncheon sponsored by the Textile Division will be addressed by Fessenden S. Blanchard, president, Textile Research Institute. The student luncheon, which traditionally attracts a record attendance, will also be held on Wednesday noon.

Prominent Speakers to Discuss Apprentice Training

Another important session under the auspices of the Committee on Education and Training for the Industries will convene on Wednesday afternoon to discuss the general topics of indentured apprentice training under war conditions, precollege vocational guidance for employment in industry, the effectiveness and value of E.S.M.W.T. (Engineering Science and Management War Training) program for industrial training at the engineering level, and special company-sponsored programs for the recent engineering-college graduate entering industrial employment.

Wednesday afternoon also gives places on the program for four other concurrent sessions on boiler feedwater, elasticity, aviation, and Diesel locomotives. Two papers on embrittlement are scheduled for the boiler-feedwater session and four for the elasticity session of the Applied Mechanics Division. The aviation session will present a paper on military airplane performance and one on cargo-glider pickup, both of which should interest a large group of engineers.

Diesel Locomotives Subject of Joint Session

The joint session of the Oil and Gas Power and the Railroad Divisions will present a progress report on Diesel locomotives under war conditions by prominent engineers representing builders and railroad operation, a progress report on gas-turbine locomotive operation by the resident engineer of Brown, Boveri & Company, Limited (Switzerland), and a paper on future Diesel-engine possibilities.

Annual Dinner to Be on Wednesday Evening

In accordance with a tradition of long standing, Wednesday evening will be devoted to the Annual Dinner. The dinner will be held in the ballroom of the Hotel Astor. If last year may be followed as a guide, members should make reservations early as the capacity of the Astor ballroom was overtaxed last year.

At the banquet President James W. Parker and President-Elect Harold V. Coes will speak. The names of the toastmaster and the principal speaker have not been made public as yet, but it is known that the latter will be a man of international importance in the present World War scene. Medals, prizes, and honorary memberships will be awarded as usual and the dinner will be followed by the Presidents' Reception and a dance.

Technical Sessions Resumed Thursday Morning

On Thursday morning the technical sessions will be resumed under the sponsorship of the Hydraulic, Railroad, and Heat Transfer Divisions, the Rubber and Plastics Group, and the Committee on Mechanical Springs.

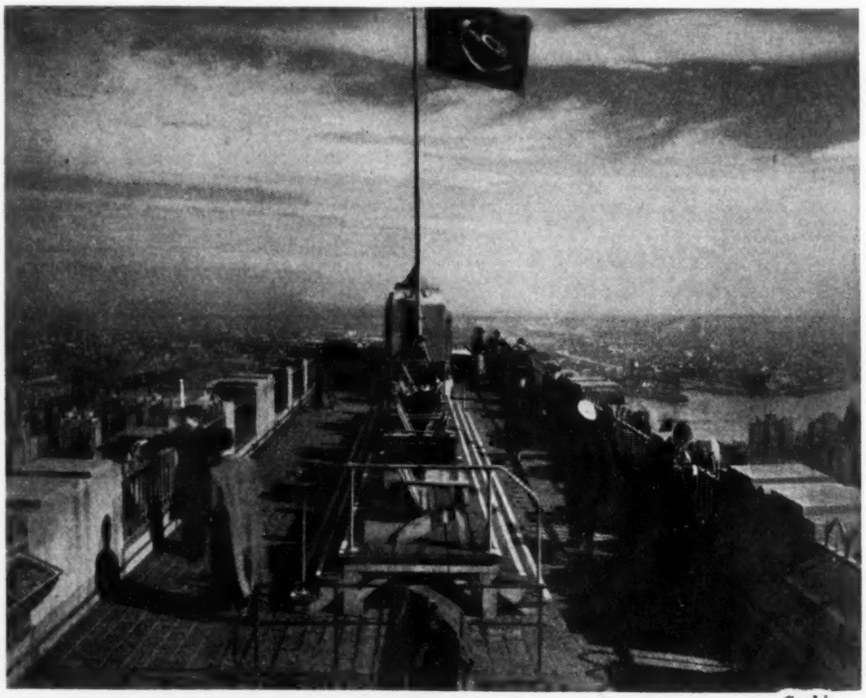
The hydraulic session will present one paper on centrifugal-pump performance as a function of specific speed. The Railroad Division's session will be devoted to personnel problems with prominent speakers representing the railroads, the Office of Emergency Management, and the railroad-supply industry.

Three papers on volute springs will be presented at the session on mechanical springs. On the subject of plastics there will be three papers and on heat transfer two papers.

McNutt to Speak on Man Power

Thursday noon will be devoted to a luncheon of the Railroad Division which will be followed by a session under the sponsorship of the Railroad Division on the important subject of man power. The Division has scheduled speakers of outstanding importance: the Hon. Paul V. McNutt, of the War Manpower Commission, Arthur C. Willard, president, University of Illinois, Miss Dorothy Sells, chief, Personnel Supply Section, Office of Defense Transportation, and Brigadier General Julian S. Hatcher, U.S.A., chief, Military Training Divi-

(*A.S.M.E. News continued on page 840*)



Cushing

ROCKEFELLER CENTER

(On the sight-seeing roof of the tall R.C.A. Building—a favorite spot with visitors.)

sion, Office of the Chief of Ordnance, Washington, D. C.

Other concurrent sessions scheduled for Thursday afternoon will be devoted to rubber, a symposium on feedwater heating cycles, aviation and applied mechanics, and heat transfer.

Sessions to Be Held Thursday Evening

Technical sessions, four in number, will be held on Thursday evening also. A symposium on marine power, similar in character to those held in recent years in co-operation with the Society of Naval Architects and Marine Engineers, will comprise six papers, all related to Diesel engines.

Other technical sessions operating concurrently on Thursday evening will be devoted to discussions of sheet and tube heat exchangers, critical-pressure steam boilers, and manufactured gas.

Program Runs Through Friday Morning

Pressure of technical papers available for presentation and discussion this year has made it necessary to hold three sessions on Friday morning, devoted to furnace heat transmission, materials handling, and the sugar industry.

College Reunions

Thursday evening will also provide, as usual, for the customary reunions of the alumni of engineering colleges, special announcements of which will appear in the final program.

The Women's Program

A committee of the A.S.M.E. Woman's Auxiliary has in preparation an attractive program of activities for the women. Plans are being made for sight-seeing and social events to provide an opportunity to make the most of a trip to New York.

Y.E.A. Smoker During the A.S.M.E. Annual Meeting

THE Yale Engineering Association is planning to hold its Annual Fall Smoker on Thursday, December 3, at the Yale Club, so that Yale men who are in New York for the 1942 Annual Meeting of The American Society of Mechanical Engineers may plan to be present.

Plans for the smoker include pictures of the fall football games and of the special forms of physical training given at the University in connection with the war program. Members of the coaching staff will be on hand to comment.

What war means to Yale academic life and to the undergraduates in New Haven will be described by Prof. Elliott Dunlap Smith who is in close touch with the national educational program and the War Manpower Commission. Further notice will be found in the A.S.M.E. Annual Meeting program.

A.S.M.E. Medals to Be Conferred at 1942 Annual Meeting

WITH impressive and appropriate ceremonies, awards and honors for the year 1942 will be conferred at the Annual Meeting of The American Society of Mechanical Engineers to be held at the Hotel Astor, New York, N. Y., Nov. 30–Dec. 4, 1942. Announcement of honorary membership in the Society, also to be conferred at the Annual Meeting, will be made at a later date. Recipients of the 1942 awards are as follows:

A.S.M.E. Medal to Ervin G. Bailey, vice-president of The Babcock and Wilcox Company, New York, N. Y., "for achievement and leadership in steam and combustion engineering."

Holley Medal to Ernest O. Lawrence, director of Radiation Laboratories and professor of physics, University of California, "for originating the cyclotron, a unique invention for producing high-speed electrified particles, and for adapting it to research in physics, chemistry, medicine, and the properties of engineering materials."

Worcester Reed Warner Medal to Fred H. Colvin, editor emeritus, *American Machinist*, "for his contributions to both technical advancement and improvement in management in the metalworking industries, as influenced by more than fifty years of articles and books—particularly the American Machinists' Handbook."

Melville Medal to J. Kenneth Salisbury, turbine-engineering department, steam-design section of the General Electric Co., Schenectady, N. Y., for his paper "The Steam-Turbine Regenerative Cycle —an Analytical Approach."

Junior Award to Winston M. Dudley, assistant professor of applied mechanics, Case School of Applied Science, Cleveland, Ohio, for his paper "Analysis of Longitudinal Motions in Trains of Several Cars."

Pi Tau Sigma Award to John T. Rettaliata, assistant engineer, Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This award is made annually for outstanding achievement in mechanical engineering.

Postgraduate Student Award to Arthur W. McClure (Princeton University), junior engineer, Turbo Engineering Corporation, Trenton, N. J., for his paper "A Specific Speed Analysis for Turbo-superchargers for Aircraft."

Undergraduate Student Award to J. Packard Laird (Princeton University), junior engineer, Carl L. Norden, Inc., New York, N. Y., for his paper "An Analysis of Motorcycle Behavior."

Remember! November 23 Is Last Date for Entries in A.S.M.E. 1942 Annual Meeting Photographic Exhibit

JUST in case you did not happen to read the invitation from the photographic division of the Metropolitan Section in the October issue, page 754, to take part in the Seventh Annual Salon of Photography and Graphic Arts to be held during the A.S.M.E. Annual Meeting at the Hotel Astor, Nov. 30–Dec. 4, we are reprinting the seven classes of entries and the necessary rules governing them.

The 1941 Exhibit was well-staged and visited by practically everybody who attended the Meeting. This year the committee is anxious to make an even better showing—the great variety of the classes will give ample scope to the imagination —and perhaps result in rather more novel entries in this war year than in years past. Read them over—send in your entry *on time* and enjoy taking part in the show.

The program for the seventh annual salon has been changed to an "all-out" war program in keeping with the times, and the separate classes for members and nonmembers have been eliminated in the interest of conservation and economy.

The photographic entries will be judged in seven classes, the winner of each class receiving a silver medal, and three entries will be selected as the three best in the salon. These will each receive a gold medal. The Graphic Arts entries will be judged in one class and two gold medals will be awarded the two best entries.

The Seven Photographic Classes

The Seven Photographic Classes are as follows:

(*A.S.M.E. News continued on page 842*)

BACKING UP THE YANKS ON OVER 30 FRONTS

The whole world is our battlefield in this war! To win we have to knock out the enemy wherever he is! You find Yanks in the Solomon Islands, China, Madagascar, India, Egypt, the Belgian Congo...and every other place that's a battlefield today or tomorrow! We've got to get there "firstest with the mostest." And come hell or high water, we shall not fail to deliver the goods.

American draftsmen, engineers and architects rely upon Dixon *Typhonite* ELDORADO to help them crystalize the material of war. ELDORADO's *sharp opaque unmistakable* lines make easy-to-read blueprints. Yes, ELDORADO as a drawing pencil is doing its part to help America shorten this war by days, weeks, months, years!

ELDORADO

PENCIL SALES DEPARTMENT, 100-J11, JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

1 *Scrap Salvage and Material Conservation*

This class includes all pictures having to do with saving and collection of scrap materials and their utilization and also methods for the conservation of materials and the use of substitutes.

2 *Members of the Armed Forces*

This class includes all pictures of soldiers, sailors, and marines, whether on duty or on leave.

3 *Civilian-Defense Activities*

This class includes air-raid precautions, Red Cross work, canteen activities, and, in fact, any civilian activities related to defense.

4 *Rationing*

This class includes all pictures related to various things connected with rationing such as the employment of substitutes of any kind for gasoline, sugar, rubber, or other rationed commodities and should give wide scope to the imagination.

5 *War Production*

This class, while unavailable to many of us, will yield many interesting pictures of both industrial and agricultural activities.

6 *Transportation*

This class includes pictures of transportation of any kind caused by or incidental to the war effort.

7 *Miscellaneous*

This class includes any pictures relating to the war effort which do not fall in one of the previously mentioned classes.

The committee reserves the right to reclassify entries in this class which they feel belong in one of the others and also to reclassify any entries which in their opinion have been entered in the wrong group.

Graphic Arts Exhibit

The theme of the Graphic Arts Exhibit is to be the war effort. All entries in this branch must have as their subject something related to the war. Patriotic poster designs will be welcome.

Entry blanks may be obtained from A.S.M.E. headquarters in New York City and the entry fee will be 50 cents per exhibitor.

Commercial Exhibit

As an added attraction to the seventh annual salon the committee desires to extend its invitation to individuals and companies to submit photographs of their various war activities. These pictures will be hung in the salon although they will not compete for the prizes. Individuals and companies will be encouraged to identify the photographs with themselves.

It is not the intention of the Committee to encourage the submission of any photographs of secret activities of any kind and all prospective entrants are hereby warned that this is a public exhibit and only pictures which could be published in a newspaper are requested. All entries will be judged on the basis of general interest, composition, and photographic excellence of technique.

Conditions of Entry

All entries must be in the name of the individual who made them. Prints in any photographic medium are eligible but no handcolored photographs will be accepted.

The entry form properly filled in together with a fee of 50 cents from each contributor must be mailed to the Salon Committee, 29 West 39th Street, New York, N. Y., so as to arrive before midnight November 23, 1942. Remittance should be made payable to the Salon Committee, The American Society of Mechanical Engineers. All prints shall be mounted on white or very light-tinted mounts of standard (16 × 20 in.) size so as to be properly displayed with the mount in a vertical position. *Each mount must bear on the back, plainly written, its number, and title, and the class in which it is entered, as well as name and return address of contributor to correspond with entry form.*

Prints may be forwarded either by post, or by express prepaid, or delivered personally. All entries shall be packed with protection for safe transportation both ways and should arrive in New York City on or before the closing date.

The privilege of reproducing any accepted picture in connection with any publicity of the salon and/or in the magazine MECHANICAL ENGINEERING will be a condition of entry. Prints will not be sold but inquiries as to any print will be referred directly to the maker.

Due diligence will be exercised in respect to the care of the prints but the Society assumes no responsibility for loss thereof or damage thereto in transit or during the Exhibition.

All entries will be returned promptly after the close of the exhibition. The submission of entries will imply acceptance of the conditions named. The judging will be done in classes described.